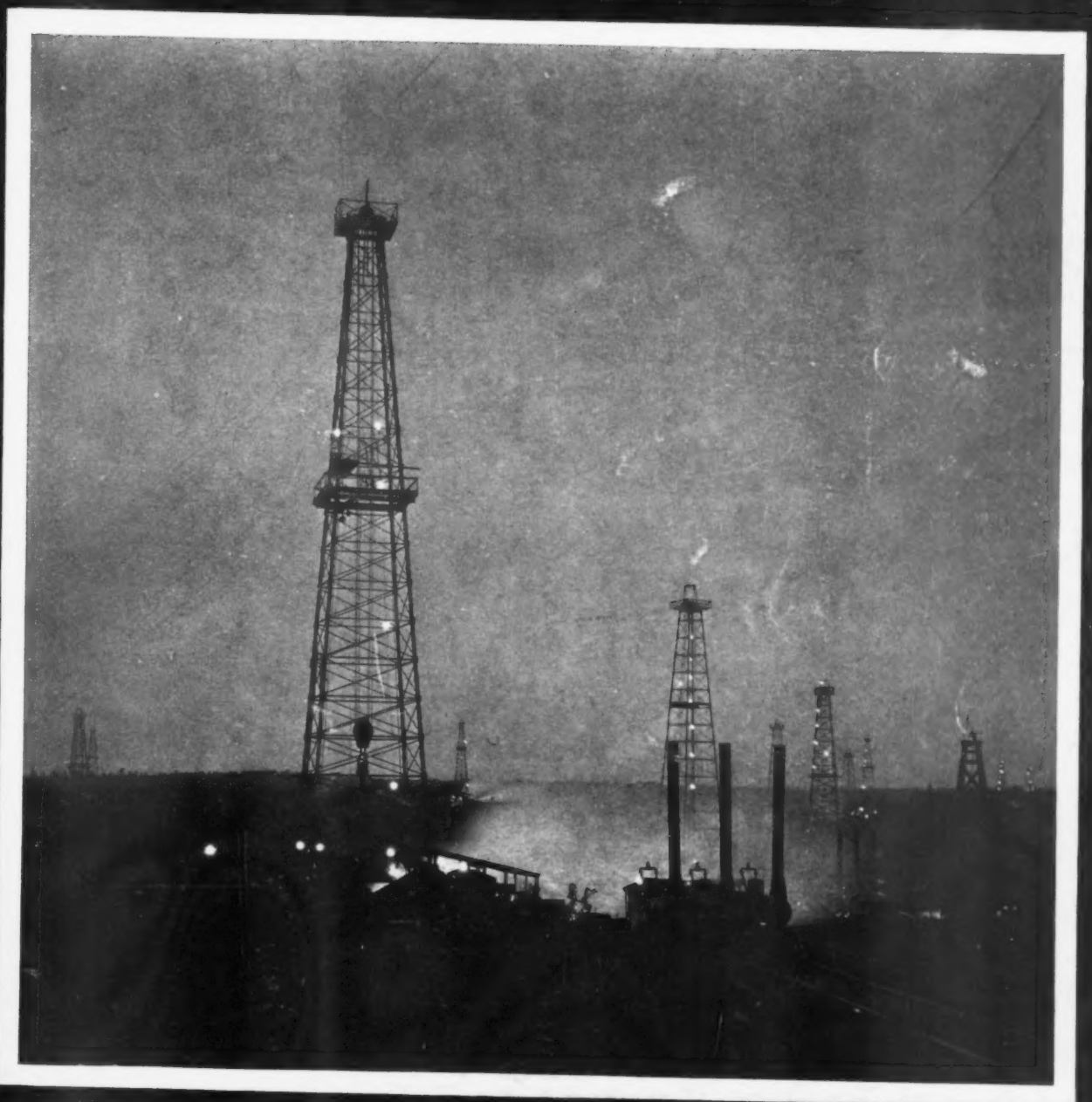

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The Processes of Contact Filtration bear a similar relation to the color and the outer tone of finished lubricating oil as does the Sharples Process to its pour point.

622.338

The Sharples Process

The Processes of Contact Filtration

The Gyro Process of Vapor Phase Cracking

The MIXITT

The SAMPLITT

MAX B. MILLER & CO. Inc.

501 FIFTH AVENUE

NEW YORK

At Which End of The Well Do You Figure Costs?

While it is true that there is a lot of money in the oil industry and the personnel of the industry is used to thinking in big figures, it does not necessarily follow that $500 or $1000 more or less on a given operation doesn't make any difference. Efficiency and net cost of production are, and must always be, of importance.

Time is an important factor, and the saving of it through more efficient equipment and methods should be given every consideration.

Equipment costs vary greatly, yet it is possible, through analysis, to buy equipment which is dependable, will give the necessary margin of safety, and will perform satisfactorily over an indefinite period of time—all at a price which may be considered nominal for the service rendered and the safety assured.

Baker Oil Well Specialties Increase Efficiency and Cut Costs

R. C. Baker is known throughout the oil industry as a practical, working oil man. He has had many years of actual field experience, and he has, so to speak, used the derrick floor as his drafting board for the designing of oil well specialties, each intended and perfected to solve a specific problem.

There isn't a "gadget" or an impractical tool or item of equipment in the entire line of Baker Oil Well Specialties. Each item has been designed, primarily, to solve a specific problem. Then it has been tested, perfected, and retested in the field. It makes good on the job.

In addition to being a practical tool, every item of equipment in the Baker line of specialties has had especial consideration from the standpoints of efficiency in operation and economy in maintenance. In short, a tool, to be worthy of the name "BAKER," must not only be worth what it costs the operator, but it must give him continued and completely satisfactory service.

Another very important factor in the manufacture of all Baker Oil Well Specialties is the quality of materials selected. R. C. Baker has always been very insistent that all materials used should be of the highest quality for the purpose for which they were to be used, with a wide margin of safety to protect the operator after he had placed them in service.

As a result of these various factors, Baker Oil Well Specialties have and hold, throughout the oil industry, an enviable reputation for soundness of basic design, for dependability in operation, for efficiency, and for economy in original cost and maintenance.

The Baker Organization is very proud of this reputation for absolute reliability, and no effort is spared to keep it bright and untarnished.

These BAKER SPECIALTIES May Be Seen at the Tulsa Exposition, Booth 99

Baker-Kammerer Pitman Weighted Counterbalance
Baker Combination Drilling Valve and Blowout Preventer
Baash-Ross (Hosmer) Auto Lock Packing Assembly
Baker-McLaine Float Plug (Screw or Slip Type)
Baker Pattern Casing Shoe
Plain, California, and Texas Pattern Casing Shoes
Cement Baskets
Cement Dump Bailers
Cement Plugs, Sure-Shot
Cement Retainers, Model B
Baker-Burch Cement Float Shoe
Baker-Burch Side Hole Cement Float Shoe
Baker Cement Baffle Collar (with hole or solid)
Cement Bull Plug Casing Shoes
Cement Float Collar
Cement Guide Casing Shoe
Cement Hook-Up No. 1
Chisel Bottom Bailers
Saw-Tooth Bottom Bailers
Cleanout Bailers
Standard Cable Tool Core Barrel
Rotary Core Barrel
Hydraulic Core Extractor and High Pressure Testing Machine
Tongs for Cable Tool Core Barrel
Drill Pipe Floats
Float Collars (Cast Iron Valve)
Float Shoes (Cast Iron Valve)
Bull Plugs, Cast Iron
Plain Shoe Guides, Cast Iron
Rotary Hole Guides, Screw Type
Rotary Hole Guides, Slip Type
Pitmans, All Metal
Rotary Shoes
Rotary Hydraulic Expansion Wall Hook
Split Shoe Guides
Baker Steel Rotary Hose
Baker Marvel Yungling Spiral Guide
Baker Marvel Screw Grab
Baker Marvel Pipe Parting Overshot

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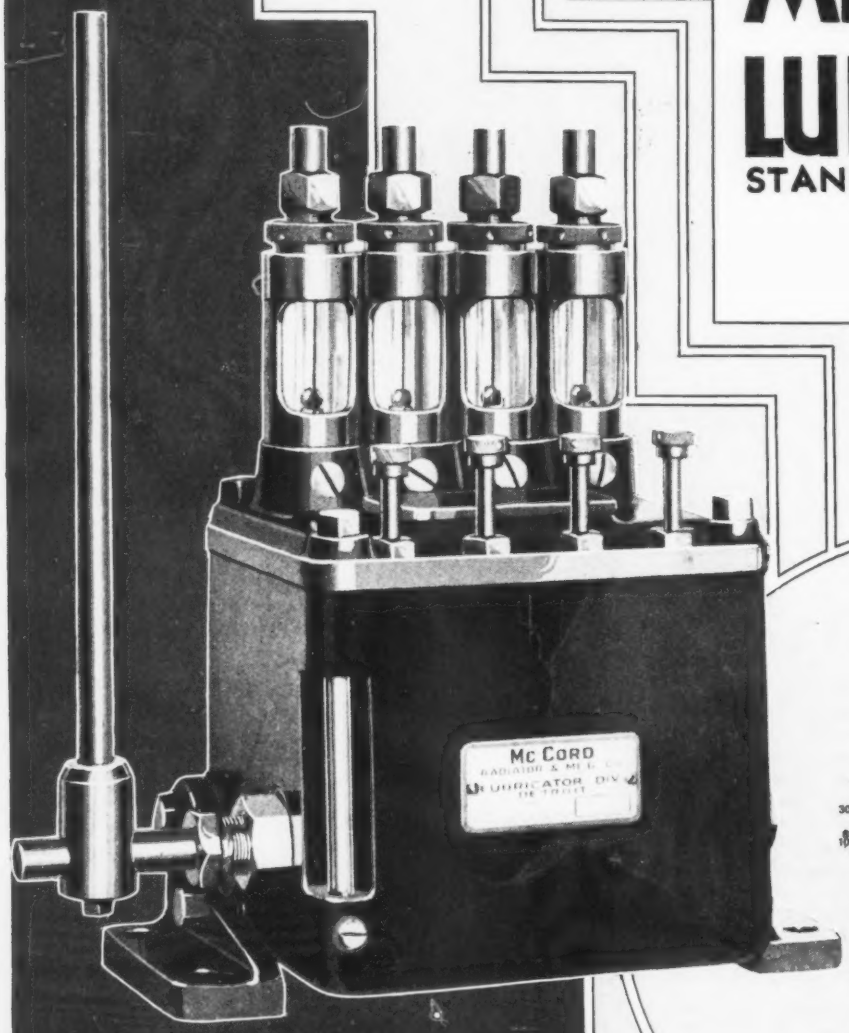
CLASS "LF"

MECHANICAL LUBRICATORS

STANDARD OF THE OIL FIELDS



A McCord Class "LF" Mechanical Lubricator installed on your pipe lines assures uninterrupted and absolutely uniform delivery of oil to power and compressor cylinders irrespective of temperature, pressure, or rate of feed; the quantity varying only with variations in speed, or manual changes in adjustment.

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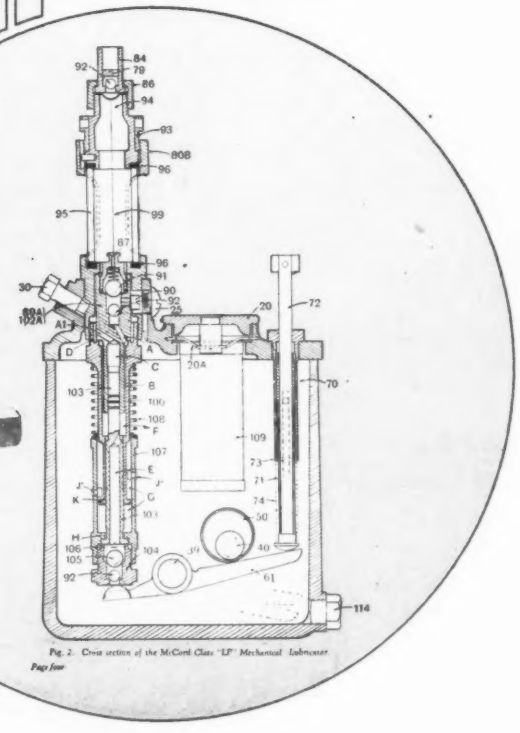


Fig. 2. Cross section of the McCord Class "LF" Mechanical Lubricator

Page four

McCORD RADIATOR & MFG. CO.
Lubricator Division
DETROIT MICH.

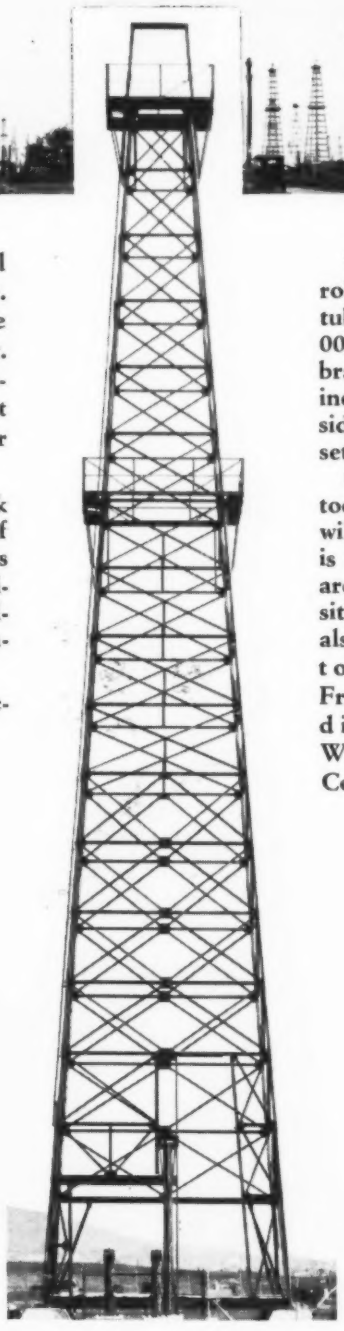
When writing McCord Radiator & Mfg. Co. *please mention The Petroleum Engineer*

TRIED AND PROVED IN THE FIELD

Our first 122-foot rotary derrick was sold and put into use in September of 1928. This derrick completed three wells in the Seminole district to a depth of 4,500 feet. It is now drilling its fourth well at Oklahoma City at 6,500 feet. Our replacement parts record shows that salvage was better than 95% on each move.

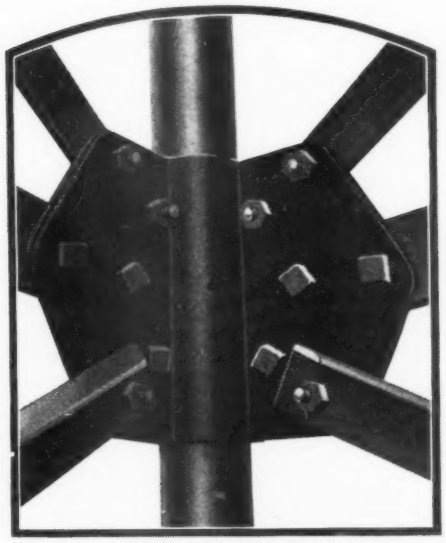
The 122′ 4-inch seamless tubular derrick has an A. P. I. crown block capacity of 416,000, with angle iron girths and braces of sufficient strength to withstand an indicated velocity of 79 miles of wind, considering a pipe setback standing in the unguyed derrick.

The 80′ 4-inch standard derrick is designed for the same strength as the 122′.

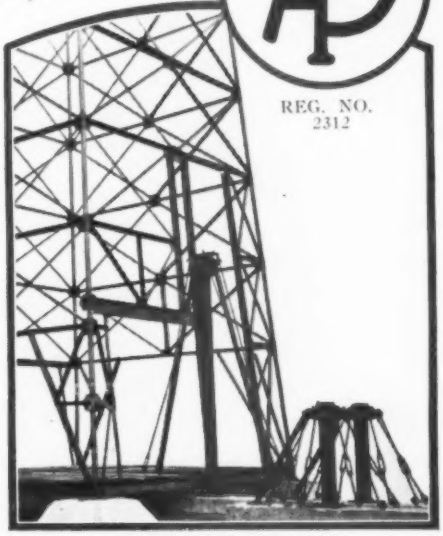


The 80′ 3-inch standard derrick of hot rolled 40-50 carbon seamless mechanical tubing has a crown block capacity of 240,000 pounds, with angle iron girths and braces of sufficient strength to withstand an indicated velocity of 90 miles of wind, considering the horizontal component of a pipe setback.

Our new 94′ combination rotary and cable tool derrick with 24′ base and 5′ 6-inch top will take either three or four-inch legs and is made to A. P. I. specifications and standards. 94′ derrick will be used on the Exposition Well. The 122′ rotary derrick will also be set up on the Exposition ground, together with the Fraser Pipe Front distributed by the Wertzberger Derrick Company.



GIRTH CONSTRUCTION



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WERTZBERGER
Derrick Company

TULSA, OKLA.

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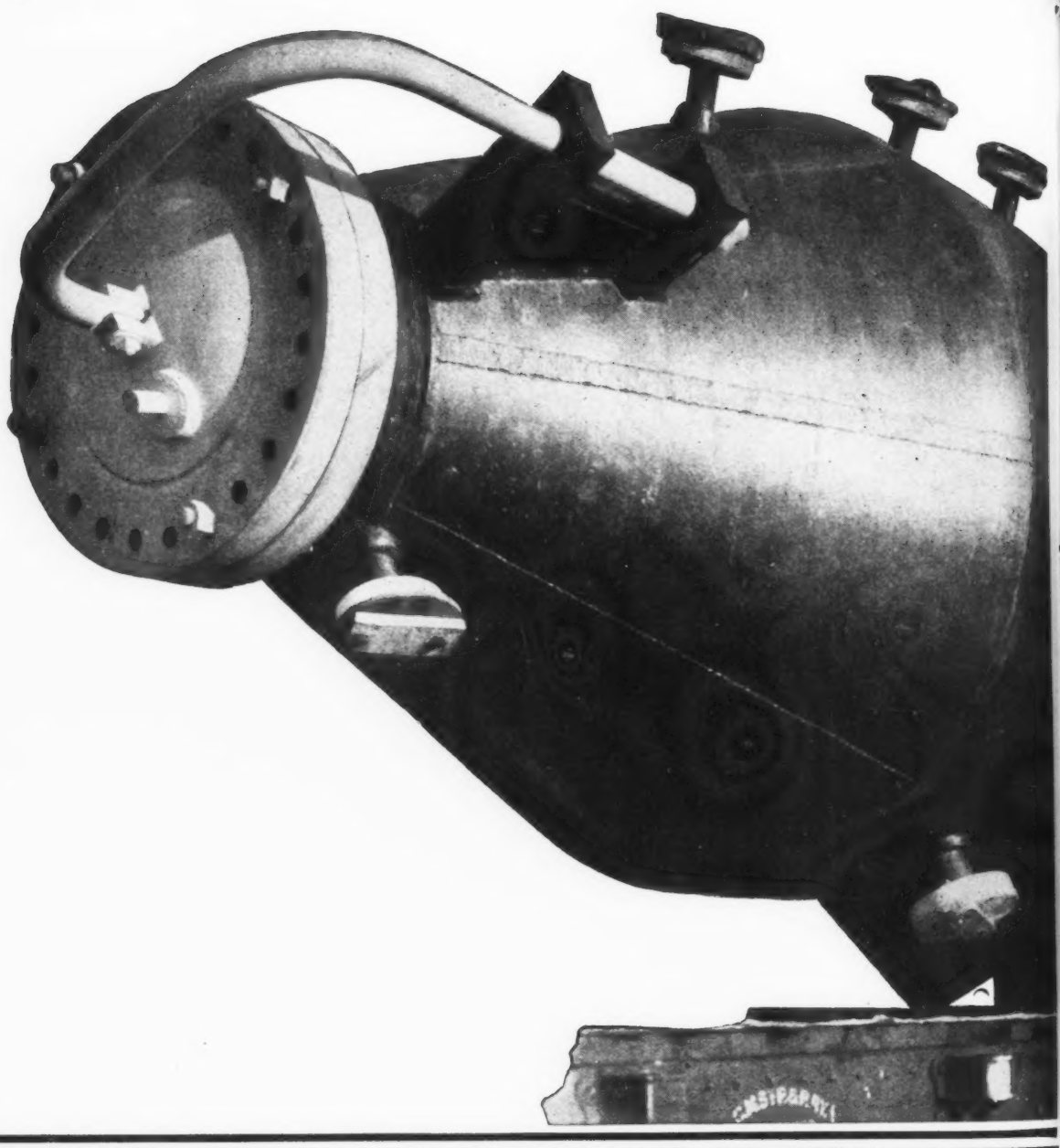

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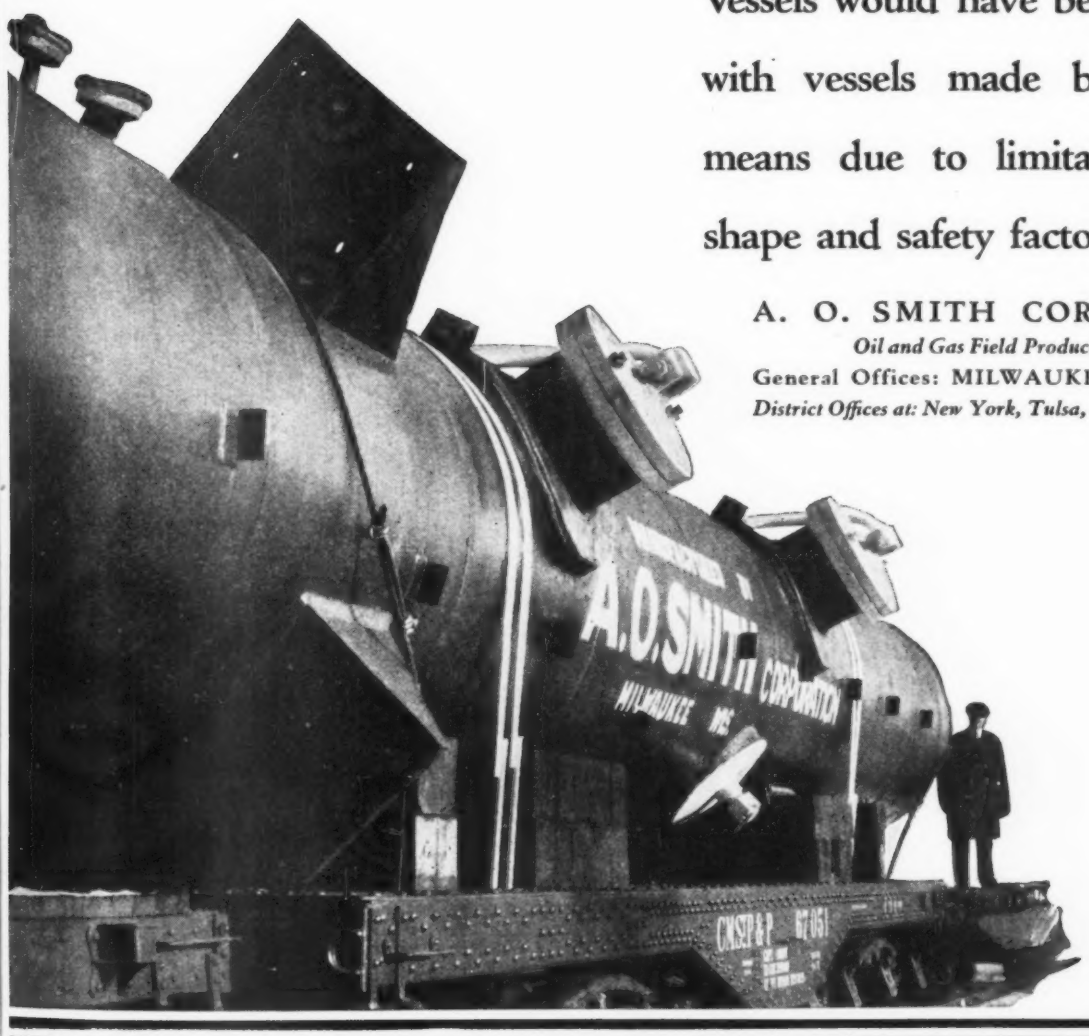

WELDED CRACKING STILLS

1909 S 1929
This book "Dependability in Steel Castings," is issued on the twentieth anniversary of the pouring of the first heat at the Sivyer Steel Casting Company on February 23, 1909.
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• • • • But to Future Progress

When we look over the extensive line of cast steel alloys that our laboratory has developed—

When we examine the routine checks that our production control men have instituted to assure uniform quality—

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—We feel that here is something in which all concerned with the design, manufacture, and sale of heavy duty equipment are interested.

For such a story involves not only the remarkable rise of steel castings to their present high place—but the opportunities which they present to industry's design, manufacture, and sale of today and tomorrow.

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In the construction of oil and gas pipe lines, as in other branches of the Petroleum Industry, SPEED plays an important part. With a notable record of pipe lines completed ahead of contract time, Williams Brothers offer the complete facilities of an organization equipped from motor trucks to airplane to obtain Speed.

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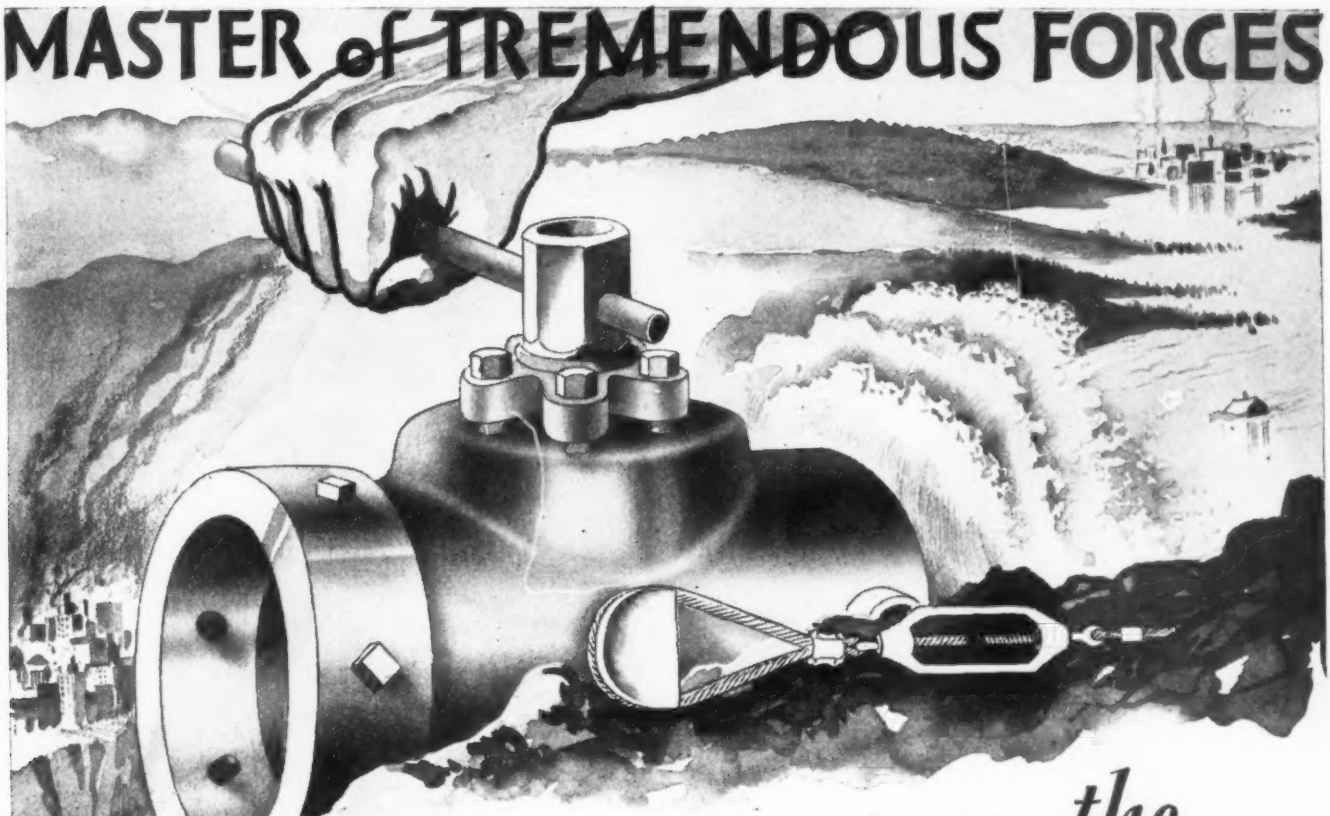

... the Control Casing Head

An irresistible wall of water, such as the Mississippi, at times, hurls toward the sea, leaves death and desolation in its wake A spouting torrent of oil, zooming from the earth, destroys lives and property just as greedily as this raging river—but for this last menace there is an unfailing master.

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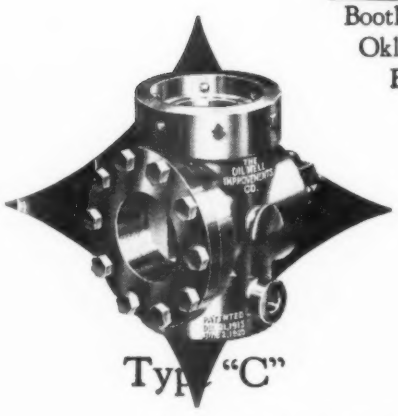

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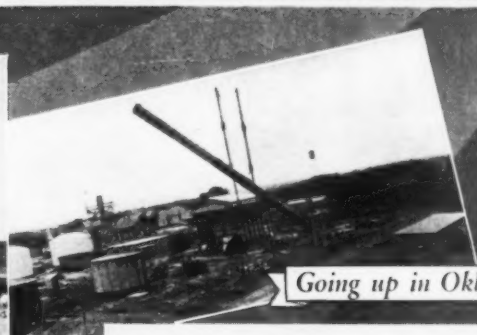

Going up in Oklahoma.

For Oklahoma Crude.

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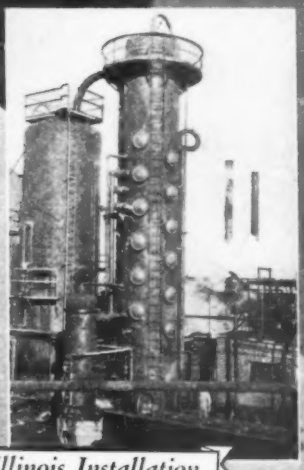

An Illinois Installation.

For several years the WINKLER-KOCH ENGINEERING COMPANY has done a big majority of all the refinery engineering work in the Mid-Continent Field—the most competitive field in America. This is one proof that this Company of highly specialized and competent engineers, devoting their entire time to the refinery industry, can help *you* with *your* problems. Specialists for over four years in remodeling and revamping existing distillation and fractionation equipment, planning and erecting complete new tube still units for various duties, gasoline recovery systems, or complete refineries. Whatever your problems may be, a wire or letter will bring full information about this service to you—without obligation of course.

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The International Petroleum Exposition is the only place where you can have the world's progress in this swiftly changing industry visualized with displays and demonstrations of the latest methods and equipment.

Where MEN METHODS and MACHINERY MEET

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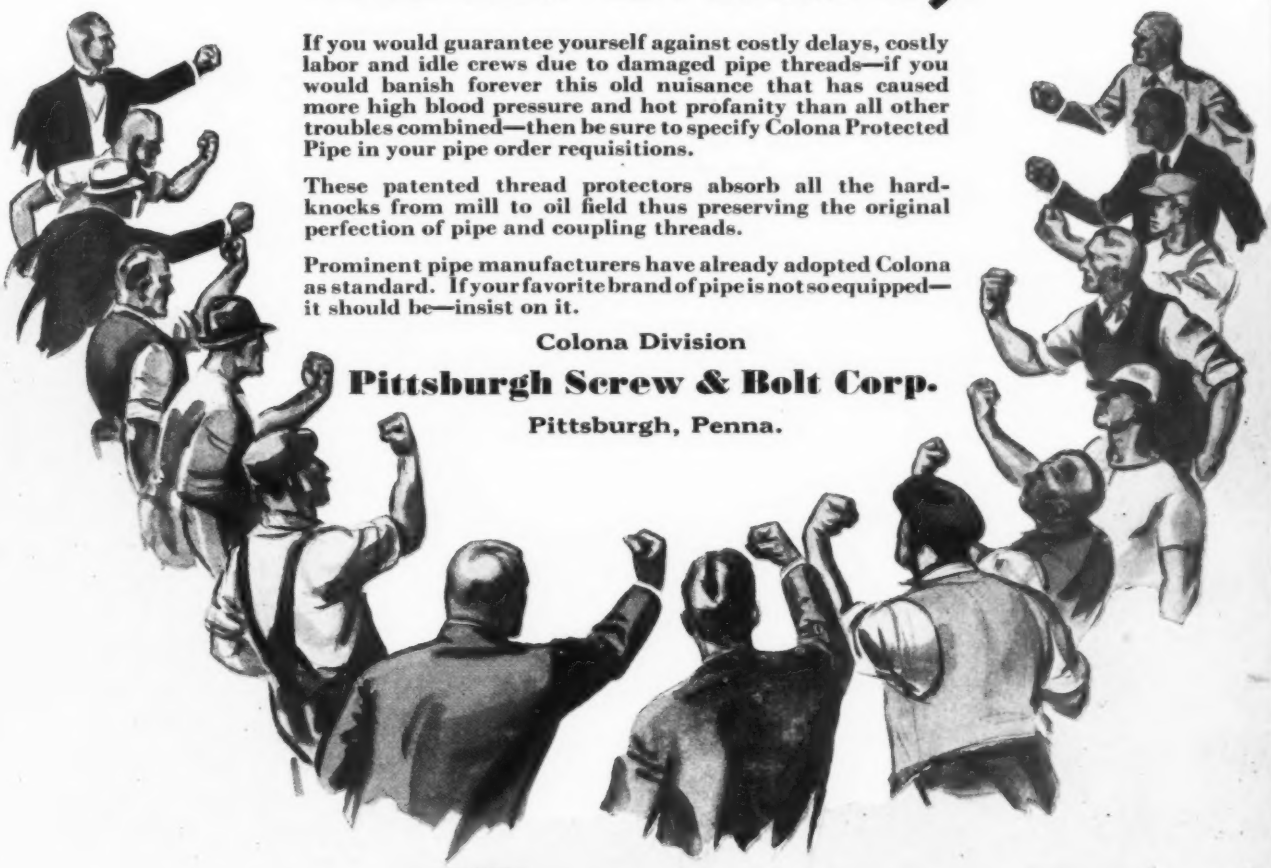
TULSA, OKLA. U.S.A. AND CONGRESS OCT. 5-12, 1929

The Word Nobody in Industry Likes "RETHREADING"

-and How to Avoid it.



If you would guarantee yourself against costly delays, costly labor and idle crews due to damaged pipe threads—if you would banish forever this old nuisance that has caused more high blood pressure and hot profanity than all other troubles combined—then be sure to specify Colona Protected Pipe in your pipe order requisitions.

These patented thread protectors absorb all the hard-knocks from mill to oil field thus preserving the original perfection of pipe and coupling threads.

Prominent pipe manufacturers have already adopted Colona as standard. If your favorite brand of pipe is not so equipped—it should be—insist on it.

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Pittsburgh Screw & Bolt Corp.

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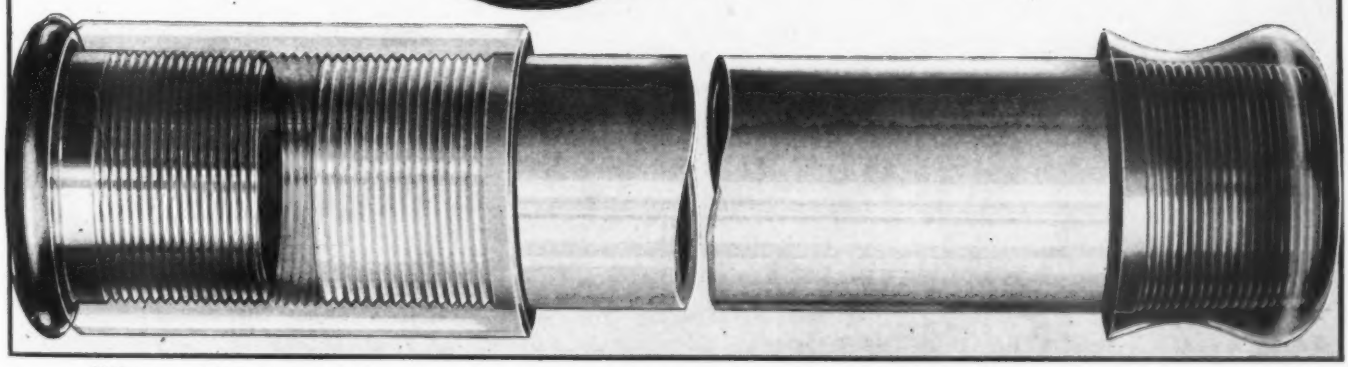

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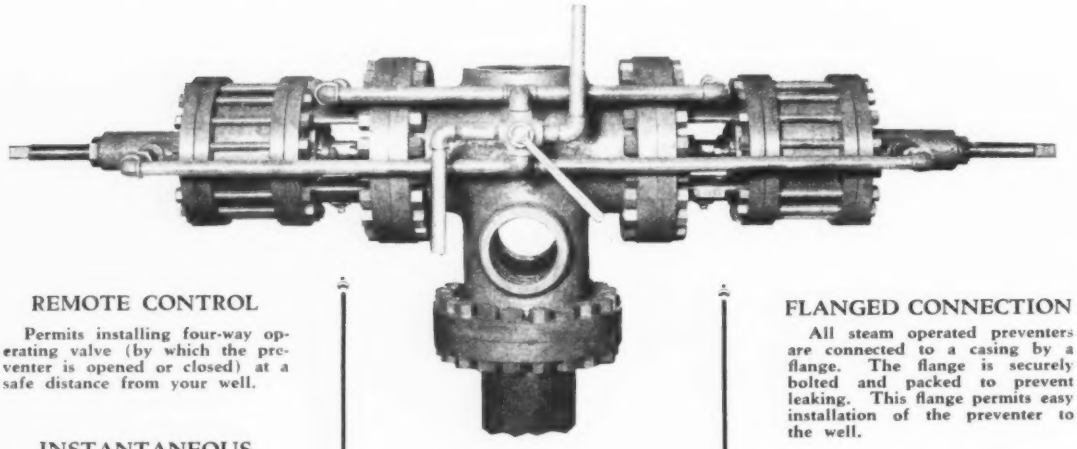
SAFETY

of men and equipment is absolutely assured when your well is equipped with

CAMERON IRON WORKS STEAM-OPERATED BLOWOUT PREVENTER

It is safe to say that no other device gives you such a great degree of safety when drilling in high pressure areas, as this new preventer.

No other Blowout Preventer is quite like the C.I.W. steam operated preventer. The many features that are exclusively its own, stand it apart in this field.



REMOTE CONTROL

Permits installing four-way operating valve (by which the preventer is opened or closed) at a safe distance from your well.

INSTANTANEOUS SHUT-OFF

Upon opening the four-way operating valve the steam drives the rams around the drill stem. This gives you instantaneous closing which is your greatest asset in preventing blowouts.

MANUALLY OPERATED LOCKING SCREWS

In the event your operating pressure is not available you can resort to the locking screws and close the preventer manually. These screws also serve to lock the rams around the drill stem after they have been closed by pressure.

MECHANICALLY OPERATED

Steam or other pressure available may be used to operate the preventer. It is only necessary to operate one valve and your preventer mechanically opens or closes.

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A single four-way operating valve controls the operation of the preventer. A quarter turn closes it and a quarter turn in the opposite direction opens it. Simple and fool proof.

FLANGED CONNECTION

All steam operated preventers are connected to a casing by a flange. The flange is securely bolted and packed to prevent leaking. This flange permits easy installation of the preventer to the well.

CIRCLE OF STEEL

When the rams are closed they form a complete circle of steel around the drill stem. The top and bottom of the rams are machined to give a flat surface for the couplings or tool joints of the drill pipe. The packing in the rams completely encircles the drill stem and prevents leaking.

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Before leaving the factory each and every C.I.W. Steam Operated Blowout Preventer is rigidly tested and guaranteed to withstand 2500 lbs. pressure per square inch

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HOUSTON TEXAS

California Distributor: Petroleum Equipment Co., 2800 S. Alameda Street, Los Angeles, California

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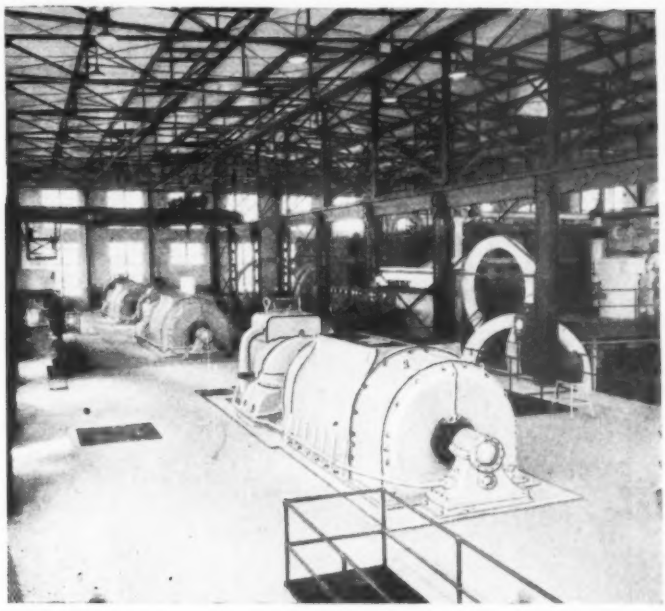

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S AFE, SATISFACTORY AND DEPENDABLE . . . . . .

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Petroleum Engineer

The Engineering Magazine of the Oil and Gas Industry

Volume 1 OCTOBER, 1929 Number 1

This issue contains

	Page
The Month's High Lights in Oildom — By J. L. Dwyer	19
Editorial	20
Some Aspects of Straight Hole Drilling — By K. C. Sclater	21
Oklahoma Pipe Line Is Model System — By J. H. Dameron	23
Modern Trend in Petroleum Refining — By F. R. Staley	28
Some Outstanding Examples of Crooked Holes	31
Current Problems of the Natural Gasoline Industry — By Emby Kaye	35
Control of Water-Cement Ratios in Oil Well Cementing — By C. P. Parsons	38
Reducing Loading Losses at Refineries — By J. J. Thomas	46
Drill Pipe Flexture and Crooked Holes — By W. P. Haseman, Ph. D.	49
Terminal Equipped For Loading Tankers in Six Hours	51
Handling "Cut" Oil in the Field — By W. A. Oberlin	57
Exposition Will Have Most Interesting Show	66
Use of Gravel in Wells Makes Information Possible	71
Difficulties of Handling Heavy Refining Equipment	73
The Importance of Lubricating Wire Rope — By M. G. Ensinger	76
Plant Makes Old Equipment New	82
The Importance of Temperature in Natural Gas Measurement — By M. K. Watson	84
Good Production From Shallow Sand in Yates Pool	86
Most Belt Troubles Caused By Clamps	88
Spurious Parts Cause Much Loss of Time and Money	90
Analysis of Olefins and Aromatic Hydrocarbons	92
Factors Entering Motor Oil Performance	94
Big Lake First Field to Have Complete Electrical Equipment	208
Weighing and Counterbalancing Wells	169
Metallurgy of Hard-Faced Drilling Bits	176
Problems and Progress in Combating Pipe Line Corrosion	164
Disposal of Oil Field Waters	166
Use and Care of Sucker Rods	112
Standardization of Electric Power Rate Schedules	104
Discussion of Sucker Rod Problems	112
Tube Corrosion From Burning Acid Sludge	100
Determination of Olefin and Aromatic Hydrocarbons	101
Combating Corrosion in Pipe Stills With Chemicals — By Gustav Egloff	190
Recovering Gasoline Vapors in the Refinery	114
Safety in the Air-Gas Lift and Gasoline Plant — By H. B. Bernard	184
Pipe Line Station Operated by Automatic Control	126
Portable Units Good in Booster Work	216
Solving Our Natural Gas Line Dust Problems — By E. F. Schmidt and D. A. Sillers	198
Much Progress Made in Long Distance Gas Transmission	204
Residue Carbide Makes Whitewash for Holding Paints in Place	66

REGULAR DEPARTMENTS

New Petroleum Equipment	116, 117-120, 121, 122
New Patents of the Industry	223, 224
Running Tour With Men in the Industry	124, 125
Laugh With Barney	128
Pictorial Petroleum	131-162 inclusive

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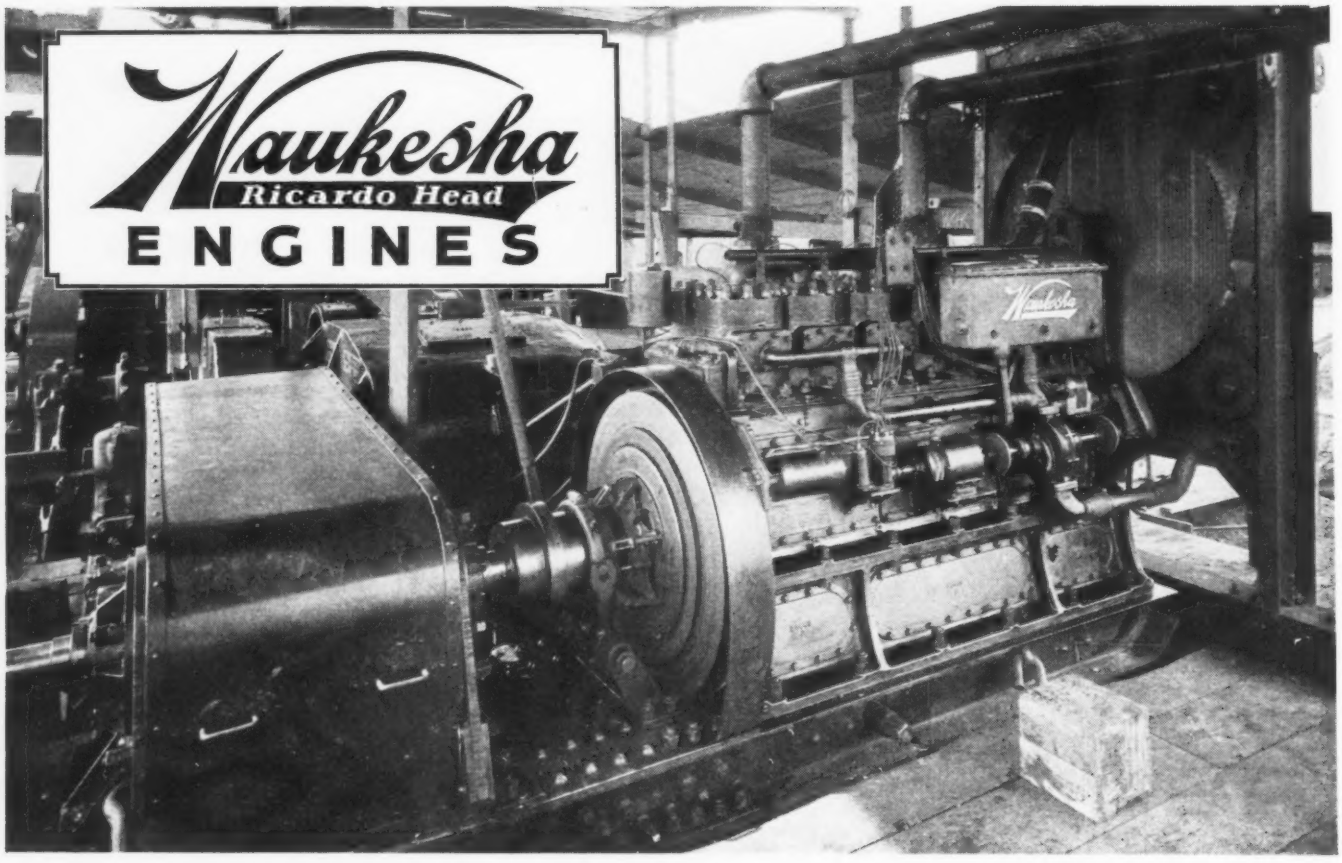

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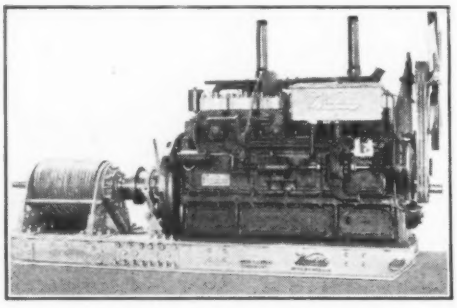

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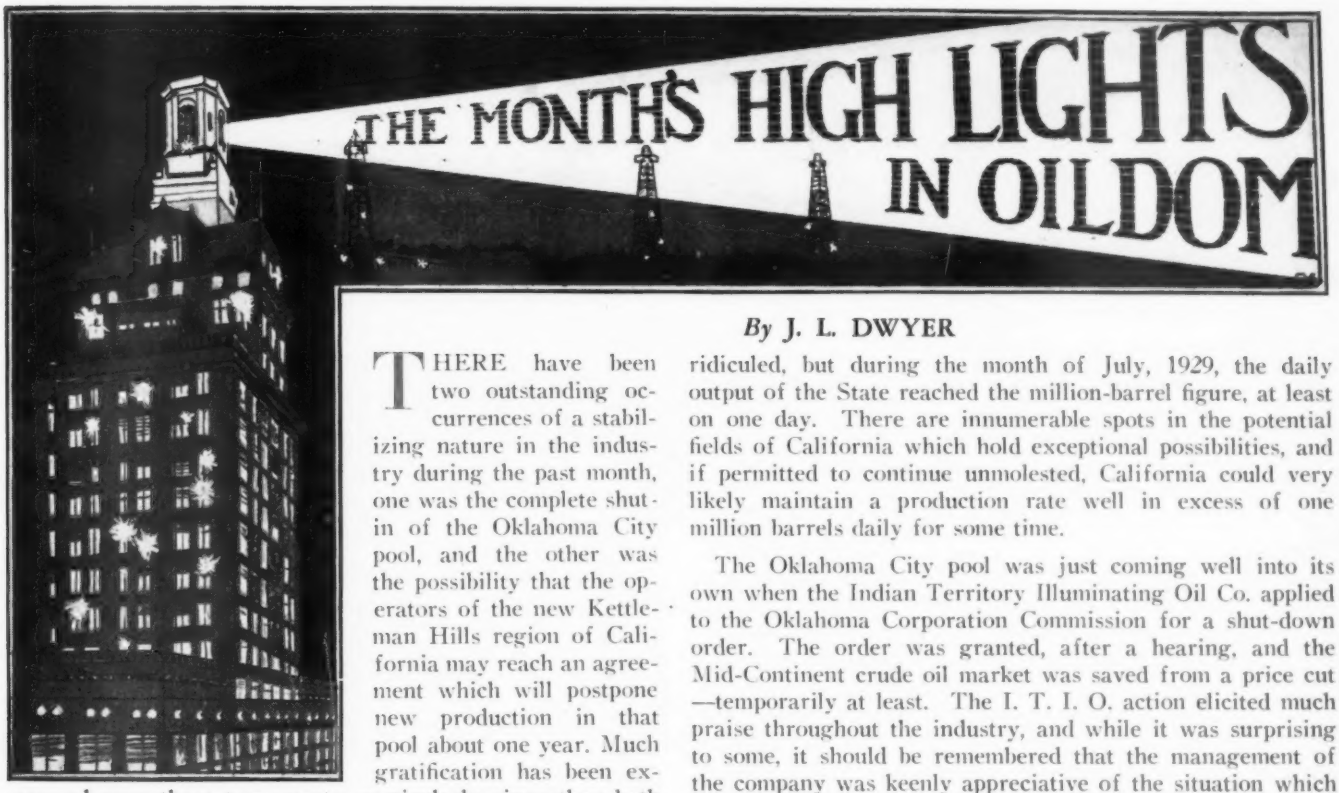


By J. L. DWYER

THERE have been two outstanding occurrences of a stabilizing nature in the industry during the past month, one was the complete shut-in of the Oklahoma City pool, and the other was the possibility that the operators of the new Kettleman Hills region of California may reach an agreement which will postpone new production in that pool about one year. Much gratification has been expressed over these two events, particularly since they both were voluntary actions.

Exceptional interest has been manifested in the California gas conservation law which was to have become effective August 31. This law, which prohibits the blowing of gas into the air, was expected to eliminate at least twenty-five per cent of the State's production, but the current figures show slight relief; while reports indicate that many producers are dissatisfied with some provisions of the law. There are certain points involving the handling of gas which comes from the oil sand that entail problems of considerable delicacy.

California has been the dominant factor in the over-production situation for the past several years. When it was suggested, about one year ago, that California could produce one million barrels of oil daily, the suggestion was ridiculed, but during the month of July, 1929, the daily output of the State reached the million-barrel figure, at least on one day. There are innumerable spots in the potential fields of California which hold exceptional possibilities, and if permitted to continue unmolested, California could very likely maintain a production rate well in excess of one million barrels daily for some time.

The Oklahoma City pool was just coming well into its own when the Indian Territory Illuminating Oil Co. applied to the Oklahoma Corporation Commission for a shut-down order. The order was granted, after a hearing, and the Mid-Continent crude oil market was saved from a price cut —temporarily at least. The I. T. I. O. action elicited much praise throughout the industry, and while it was surprising to some, it should be remembered that the management of the company was keenly appreciative of the situation which confronted them. To allow the flood of oil to continue at Oklahoma City would have meant producing the oil at a price at least twenty-five cents per barrel below the current price. All Mid-Continent producers will benefit by the far-sightedness of the Indian Territory management.

It only requires a very casual glance at the oil production figures of the industry during the summer of 1929 to realize that the steady position of the crude price structure was almost a miracle. From the middle of May until August 31, there was an increase of 343,000 barrels in the daily average production of the United States, and yet there was no price reduction.

Since this increase in production was considerably more than market conditions could assimilate, it was accompanied by an increase in crude oil and refined stocks.

Production and Refining Figures Furnished by the AMERICAN PETROLEUM INSTITUTE

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks, Week Ending September 21st

(Barrels of 42 Gallons)

DISTRICT	Per Cent Potential Capacity Reporting	Crude Runs to Stills	Per Cent Operated of Total Capacity Reporting	Gasoline Stocks	Gas and Fuel Oil Stocks
East Coast	100.0	3,593,000	90.5	4,359,000	9,118,000
Appalachian	89.1	605,700	83.9	810,000	768,000
Ind., Ill., Ky.	98.7	2,175,900	94.0	4,267,000	3,624,000
Okla., Kan., Mo.	79.7	1,968,500	82.7	2,189,000	4,325,000
Texas	90.1	4,161,500	89.8	4,194,000	12,931,000
Louisiana-Ark.	96.7	1,295,900	76.0	1,792,000	5,238,000
Rocky Mountain	93.4	447,900	51.6	1,746,000	965,000
California	98.7	4,978,200	85.7	13,045,000	108,099,000
Total Wk. Sept. 21	94.0	19,226,900	85.8	32,402,000	145,068,000
Daily Average	.....	2,746,700	.....	.....	.....
Texas (Gulf Cst.)	100.0	3,295,500	93.5	3,569,000	9,806,000
La. (Gulf Coast)	100.0	875,300	80.6	1,533,000	4,396,000

Daily Average Production

(Figures in Barrels)

	1929 Sept. 21	1929 August 24	1928 Sept. 22
Oklahoma	698,600	727,350	731,750
Kansas	128,850	128,650	99,550
Panhandle Texas	121,950	133,850	60,900
North Texas	96,600	95,500	88,550
West Central Texas	58,250	58,500	54,950
West Texas	366,300	374,200	348,250
East Central Texas	18,000	17,950	21,600
Southwest Texas	73,250	78,200	25,800
North Louisiana	36,700	36,350	38,950
Arkansas	64,700	66,700	85,100
Coastal Texas	133,700	134,000	107,700
Coastal Louisiana	22,650	20,600	21,450
Eastern	137,500	127,500	112,500
Wyoming	55,400	58,050	62,150
Montana	11,500	11,500	9,550
Colorado	6,500	7,000	6,550
New Mexico	3,550	2,550	2,050
California	890,500	887,900	631,500
Total	2,924,500	2,966,350	2,508,850

Appreciation

IN PRESENTING this, the first issue of THE PETROLEUM ENGINEER to the oil and gas industry, we acknowledge our indebtedness to several groups of individuals whose whole-hearted co-operation contributed enormously toward making successful our efforts to set a high standard of excellence from the start . . . Realizing at the outset of our publishing venture that whatever success we were to enjoy would depend wholly upon our giving the men engaged in the operating divisions, for whom THE PETROLEUM ENGINEER is edited, an interesting and beneficial magazine, we consulted with scores of men of accomplishment in the industry before formulating our plans. We found these men altogether willing to discuss our problems with us and to give us the benefit of their long experience by way of suggesting many features which they considered essential to the type of publication we proposed. A large number of their suggestions have been put into effect and have added materially to the quality of the magazine. For the assistance of these benefactors we are extremely grateful.

From the time of the first announcement of THE PETROLEUM ENGINEER we have received letters from men of importance in oil and gas companies over a broad range of territory complimenting us upon the foresightedness of our ideas and assuring us of the need for a magazine of its character. We sincerely thank all of those who so kindly encouraged us in this manner. We assure them that their letters caused us to strive earnestly to merit their interest in us.

We thank also the officials of oil and gas companies all over the world who so readily furnished us with the names of the men in their operating divisions whom they wished to receive THE PETROLEUM ENGINEER. These lists are very complete and we are confident the senders will be more than repaid for their courtesy by the benefit their men receive from reading our publication.

To the contributors whose articles appear in this issue and the many who have promised to write for us in the future we are exceedingly grateful. All of this month's contributors are men actively engaged in either the oil or gas business, many in high executive capacities. These men have written about the problems they themselves have encountered in the past or with which they are dealing every day. What they have said bears the stamp of authoritativeness and we are certain the readers of THE PETROLEUM ENGINEER will find each article interesting and highly instructive.

Finally, we owe a debt of profound gratitude to the exceptionally large number of advertisers who accepted us at face value and contracted for advertising without so much as having seen a single issue of THE PETROLEUM ENGINEER. To do this required confidence in the ability of the men behind the publication and we shall endeavor faithfully to prove ourselves worthy of this confidence.

We believe we are justified in saying that we are pleased with this issue of THE PETROLEUM ENGINEER. Editorially every branch of the industry with which we deal has been covered by expert writers who have had much of value to say. From the standpoint of volume of advertising, we are informed that this is the largest initial issue of any industrial publication ever printed. We are justly proud of that record.

However, well pleased as we are with Volume 1, Number 1, we are not *satisfied* with it. It shall be our constant aim to make each successive issue better than the one preceding. Fortunately we are not bound by a traditional way of doing things. As we see the need for changes which we believe will represent a step forward, such changes will be made. Future policies, as those already adopted, will be regulated by the needs of the men in the operating divisions of the petroleum industry.

Summing up, the promising beginning of THE PETROLEUM ENGINEER has been substantially furthered by the timely support of our friends and the fact that each member of our organization has had the advantage of being well-known in the industry and his ability respected. However, these two factors, necessary as they are, would have counted for little but for the most essential facts that *there is a definite and distinct field for our type publication and the basic principles upon which* THE PETROLEUM ENGINEER *is published are sound.*

L. Morris

President.

Some New Aspects of

Straight Hole Drilling

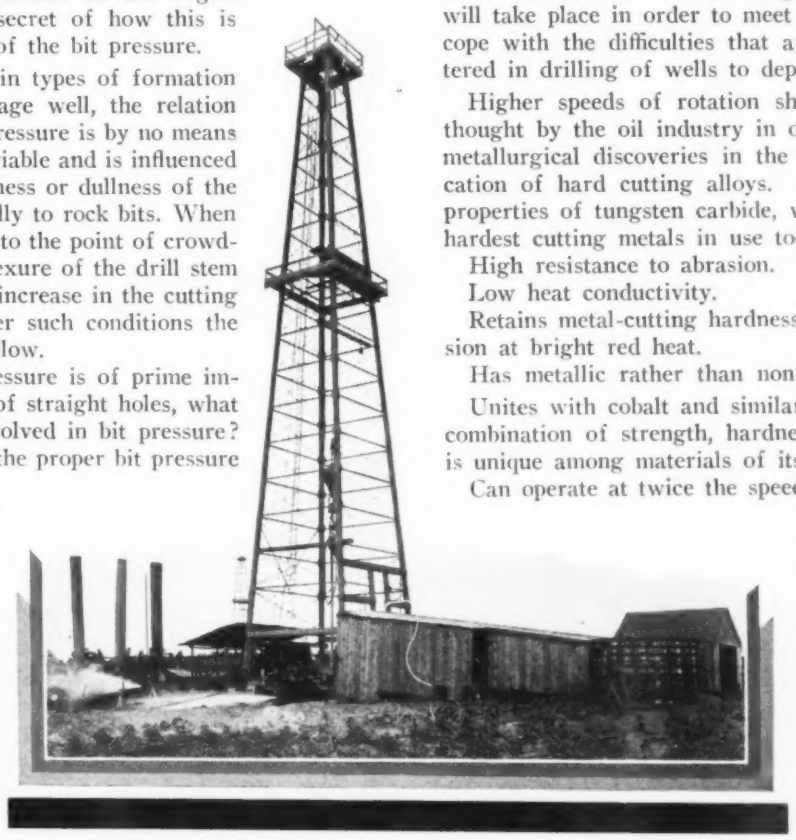
By K. C. SCLATER

AMONG the many causes contributing to the deviation of holes from the vertical, the most important, according to those who have investigated the problem and given it close study, is too much weight on the bit. Justifying the soundness of this opinion is the remarkable progress that is now being made in drilling relatively straight holes with rotary tools, through paying strict attention to, and maintaining close control of, the weight on the bit. A competent observer, who has been giving some attention to the problem of drilling straight holes, recently implied the importance of weight on the bit by stating that making gravity do its full duty in keeping the hole straight calls for less weight on the bit.

Weight on the bit, or bit pressure, is a function of the speed of rotation. The higher the speed of rotation, the smaller the amount of bit pressure necessary for efficient cutting action. High speeds of rotation also reduce the torque necessary on the drill stem in drilling operations. A good example, demonstrating to what extent bit pressure can be reduced by increasing the speed of rotation, is found in the drilling of holes in diamond dies for the wire drawing of precious metals. Small holes, only a few thousandths of an inch in diameter, are drilled in diamonds with a drill consisting of a piece of soft copper wire coated with diamond dust. The soft copper wire usually is much smaller in diameter than the hole to be drilled, hence cannot stand much pressure. Nevertheless, by using enormously high speeds of rotation it is possible to drill a straight and true hole in a diamond with this frail drill which will yield and bend to the slightest pressure of the finger. The main part of the secret of how this is done is, perfect control of the bit pressure.

Due to the difference in types of formation encountered in the average well, the relation between torque and bit pressure is by no means constant. It is highly variable and is influenced profoundly by the sharpness or dullness of the bit. This applies especially to rock bits. When the pressure is increased to the point of crowding on a dull rock bit, flexure of the drill stem occurs, with little or no increase in the cutting action of the bit. Under such conditions the bit usually starts to wallow.

Conceding that bit pressure is of prime importance in the drilling of straight holes, what are the main factors involved in bit pressure? Any study to determine the proper bit pressure to use in any given case should take into account the following factors: Type of bit, its size and shape; size and type of drill stem; size of hole, its depth, verticality, condition of wall, and changes in diameter; type of formation, its hardness and dip; working conditions, including speed of rotation, weight of mud, and rate of circulation.



With the exception of the type, hardness, and dip of the formation, every factor enumerated can be controlled. The relative importance of each is not constant, but will vary with field conditions. To make an appraisal of these factors under different field operating conditions necessitates the careful compilation of a vast amount of field data and a painstaking analysis of same. Unfortunately, there are not sufficient field data of a dependable nature available which takes into account all these factors, hence, an evaluation of bit pressures cannot be made. Investigations along this line are now in progress. The A. P. I. Division of Development and Production Engineering has appointed committees composed of field men in the various districts to gather the necessary data and make a study of bit pressures in connection with the problem of straight hole drilling practice.

Speed of Rotation

It was stated that higher speeds of rotation would reduce the pressure necessary for efficient cutting action of the bit. Present speeds of rotation in rotary drilling practice are considered by many too low for the best cutting efficiency. However, when we speak of going to higher speeds of rotation, we are immediately confronted with the prospect of serious mechanical difficulties which, with many of the present types of rotary drilling equipment in general use in the oil fields, may be hard to overcome. Already faced with the prospect of 10,000-foot wells, it is almost certain that some modifications in the design of drilling equipment will take place in order to meet the new conditions and cope with the difficulties that are bound to be encountered in drilling of wells to depths of 10,000 feet.

Higher speeds of rotation should be given serious thought by the oil industry in order to profit by recent metallurgical discoveries in the manufacture and application of hard cutting alloys. Consider some of the properties of tungsten carbide, which is the base of the hardest cutting metals in use today:

High resistance to abrasion.

Low heat conductivity.

Retains metal-cutting hardness and resistance to abrasion at bright red heat.

Has metallic rather than non-metallic structure.

Unites with cobalt and similar materials to produce a combination of strength, hardness and toughness which is unique among materials of its class.

Can operate at twice the speed of high-speed steel, on a given cut, for a given length of time, which breaks down the edge of high-speed tool steel without showing any appreciable wear.

Brinnell hardness, 1,800 to 2,400, compared with 800 for hardened high-speed steel.

Cutting speeds in

metal working well in excess of 600 feet per minute are possible.

Strength is just over one-half that of high speed steel. (This limits the permissible bit pressure.)

Large automobile manufacturers and others engaged in metal-working operations have been quick to recognize the possibilities of these hard alloys for cutting tools. Overnight, production has been speeded up to a point almost undreamed of a few years ago. For example, quoting from a recent article[1] on hard cutting metals:

> "One of the most remarkable, not to say startling, results observed in actual production work with tungsten carbide tools, was obtained in drilling brass bushings made from hard rolled stock. The tools formerly used for this work were reground every two hours and had to be replaced after drilling about 600 pieces. Drills of the same general construction, with tungsten carbide inserts at the cutting lips, averaged about 175 hours between grinding and produced 50,000 pieces. The cost of the tungsten carbide inserted cutting-edge tool was about ten times that of the steel formerly used."

The number of parts produced was increased over 80 times that previously possible, while the need for grinding was only 1/87th of that formerly required. These results are amazing. Quoting from another article[2] on the results obtained from tungsten carbide cutting tools:

> "Another specific instance of speeding up production is in the manufacture of a transmission drum for an automobile. With the best tools previously available, this drum, which is of cast iron, cast in a permanent mold and very hard on the surface, was machined at a cutting speed of 190 feet per minute. With Widia (a tungsten carbide metal), this is being done at 592 feet per minute. The previous production time was 75 seconds, whereas with the new material, this part is being made in 20 seconds, or practically four times as fast as before. The previous tool needed regrinding after every 25 drums machined, whereas the Widia tool only needs regrinding after every 100 drums machined. This work is done without change in equipment, other than the change to Widia tools and speeding up the machines."

Hard facing metals have been in use for some time in the oil industry and have speeded up drilling operations and effected economies. Wider use and field experimentation with so-called diamond substitute metals should spell further progress.

Speeds of rotation necessary to obtain the full benefits of the inherent cutting efficiency of those cutting alloys of almost diamond hardness will be governed by the size and type of bit, also by the methods used in placing the alloy on the bit. It probably will be found that rotational speed limitations will be imposed by mechanical considerations rather than the physical properties of the alloy itself. Since the bit pressure and the torque exerted on the drill stem for proper cutting efficiency will be less than at lower speeds of rotation, it may be possible to use a lighter drill stem. This would increase the tendency of the drill pipe to whip in the hole. Trouble from this source could be eliminated however, by placing guides at suitable intervals on the drill stem. A reduction in the size of drill stem would offset the increased power losses resulting from the higher speeds of rotation. Tests made on a hole about 3,700 feet deep, with a 10-inch fish-tail bit on a 4-inch drill stem rotating freely off bottom at 83 revolutions per minute, showed a power consumption of 35 H. P. Methods of reducing power losses due to skin friction and the resistance encountered by the bit rotating in mud fluid at high speed would require special study. At higher speeds of rotation, adequate provision for proper cooling of the bit would also be necessary. This involves the matter of bit design as well as good mud circulation. Proper flushing of the cutting edges and good circulation around the body of the bit would be of increased importance at high speeds of rotation, regardless of the type of formation being drilled. Based on the experience of metal working practice, it is to be anticipated that variations in the hardness of formations would give less trouble at higher speeds of rotation.

Modifications in design, necessary to meet the operating conditions at higher speeds of rotation, will be influenced largely by the progress made in the development of equipment and methods for the closer control of bit pressure at great depths. The matter of controlling bit pressure is today receiving the attention of some of the best minds in the industry, especially as it pertains to straight hole drilling practice. There is good reason to believe that this phase of the problem is near practical solution. Several pieces of equipment and methods now in the process of development show promise of successful practical application to the sensitive and accurate control of bit pressure, and it should be only a short time until these will be available to the industry.

Success in drilling holes in the Seminole district, the deviations of which from the vertical do not exceed 1½ degrees, has been achieved through the use of specially designed guides placed immediately above the bit. These guides are of ample length and size to prevent flexure of the pipe in the hole. Concentration of extra weight at the bottom of the drill stem, it is claimed, also permits better control of the pressure on the bit. These results were obtained without any sacrifice in drilling speed and an absence of trouble from twist-offs. Such results are indicative of the progress possible in the promotion of good drilling practice, when the need becomes imperative, as is the case in the comparatively narrow limits of deviation from the vertical now insisted upon by many companies.

It is safe to predict, from a review of recent progress in the drilling of straight holes, that during the next few years revolutionary strides will be made in the development of new methods in deep well drilling. Straight holes will then be the rule rather than the exception.

[1] "Tungsten Carbide Tools for Production Work" (*Machinery*, April, 1929, p. 621).

[2] "Widia, a Tungsten Carbide Cutting Metal," by Rodger D. Prosser (*Machinery*, May, 1929, p. 692).

Payne Now Oil Well Treasurer

LEON F. PAYNE, formerly credit manager of Carnegie Steel Company, has been elected treasurer of the Oil Well Supply Company to succeed Mr. H. H. James who has been elected vice-president in charge of manufacturing.

Mr. Payne is a graduate of Brown University and began his business career in 1907 with the sales department of the Western Electric Company. In 1909 he became associated with Carnegie Steel Company and has served this company continuously since that time. His first year was spent in the sales department but in 1910 he transferred to the credit department, becoming head of the department in 1918 and continuing in that capacity until the present time.

Oklahoma Pipe Line Is Model System

By J. H. DAMERON

SPOTLESS main line stations, laid out to facilitate operation and maintenance as well as promote safety, and landscaped sites are the pride of the operating personnel of the Oklahoma Pipe Line Co. Built upon this pride is a spirit found all the way down the line to shave operation costs at every turn, promote safety work and effect many and substantial savings through the salvaging of otherwise junk material. This transporting company, with around 900 miles of main lines reaches into virtually every major producing area in Oklahoma and Kansas. Its crude is delivered to the Standard Pipe Line Co. of Louisiana at DeQueen, Ark. The latter carrier moves it on south to an affiliated producing company's refinery at Baton Rouge or on to the coast by barges from Baton Rouge to the coast.

Throughout this entire system the combined results of the construction and operation plans are producing results that are modestly reported satisfactory. To the observer there is a substantial increase in overall efficiency of material and men.

Layouts for the most recent main line stations use 28 per cent of the wall area for lighting and ventilation. The buildings are fireproof in construction and are built with steel, concrete and brick. The walls carry no load other than their own weight and the steel skeleton supports the roof and craneways. They are laid out to afford plenty of freedom of movement, made easier to keep clean and to promote safety through the elimination of stumbling and tripping hazards.

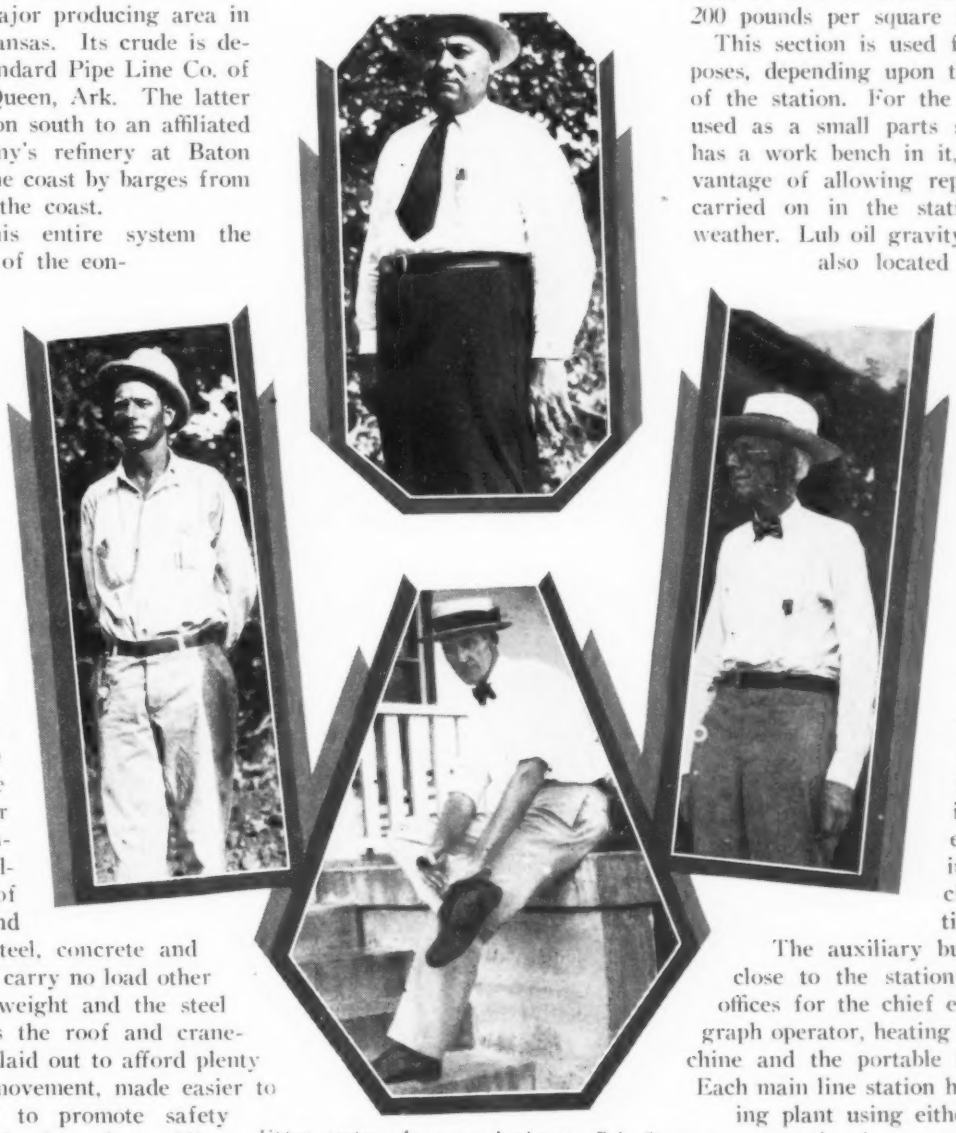
In line with the company's practice of standardization, standard size steel sashes and doors are installed on the main line and booster stations whether they are fireproof or frame constructed. This affords more durable construction as well as giving a higher salvage value and the advantage of having standard equipment. To minimize roof repairs and painting all main line station roofs are made with cut corner sheet asbestos put on in sheets and held secure with bolts and J-clips.

For convenience of the station crews, showers and locker rooms are located on the engine room side of the stations and are concealed with art metal. These stations are equipped with all modern water and sanitary conveniences. Above these rooms is a storeroom with a concrete floor built to hold a maximum dead load of 200 pounds per square foot.

This section is used for various purposes, depending upon the requirements of the station. For the most part it is used as a small parts stock room and has a work bench in it, giving the advantage of allowing repair work to be carried on in the station during bad weather. Lub oil gravity feed tanks are also located in this section of the building.

Here will be found a detailed safety precaution in the kick plate and toe board extending around the exposed part of the half floor. It butts flush with the floor and is bolted to the steel railing preventing small parts from rolling off on the engines and helping to prevent accidents to the station crew.

The auxiliary building is located close to the station and houses the offices for the chief engineer and telegraph operator, heating plant and ice machine and the portable fire extinguisher. Each main line station has a central heating plant using either gas or oil and automatic in operation. A vapor vacuum closed-type system is used and pulls the cool water from the radiators back to the boiler where it is reheated and returned. Where practical plants have been raised to ground level eliminating the necessity of going below ground level to get the advantage of gravity and thus avoid seepages and making it easier to keep clean. In the same room with



Upper center—An unusual picture; Bob Sparrowhawk, division superintendent Oklahoma Pipe Line, taken without a cigar. Left—"Cowboy" Tollard, construction foreman (Bob says this boy can lay a mile of line a day in the field and 50 miles a day in the hotel lobby). Right—W. S. Foster, chief engineer of the company. Lower center—Floyd M. Warterfield, Jr., assistant chief engineer.

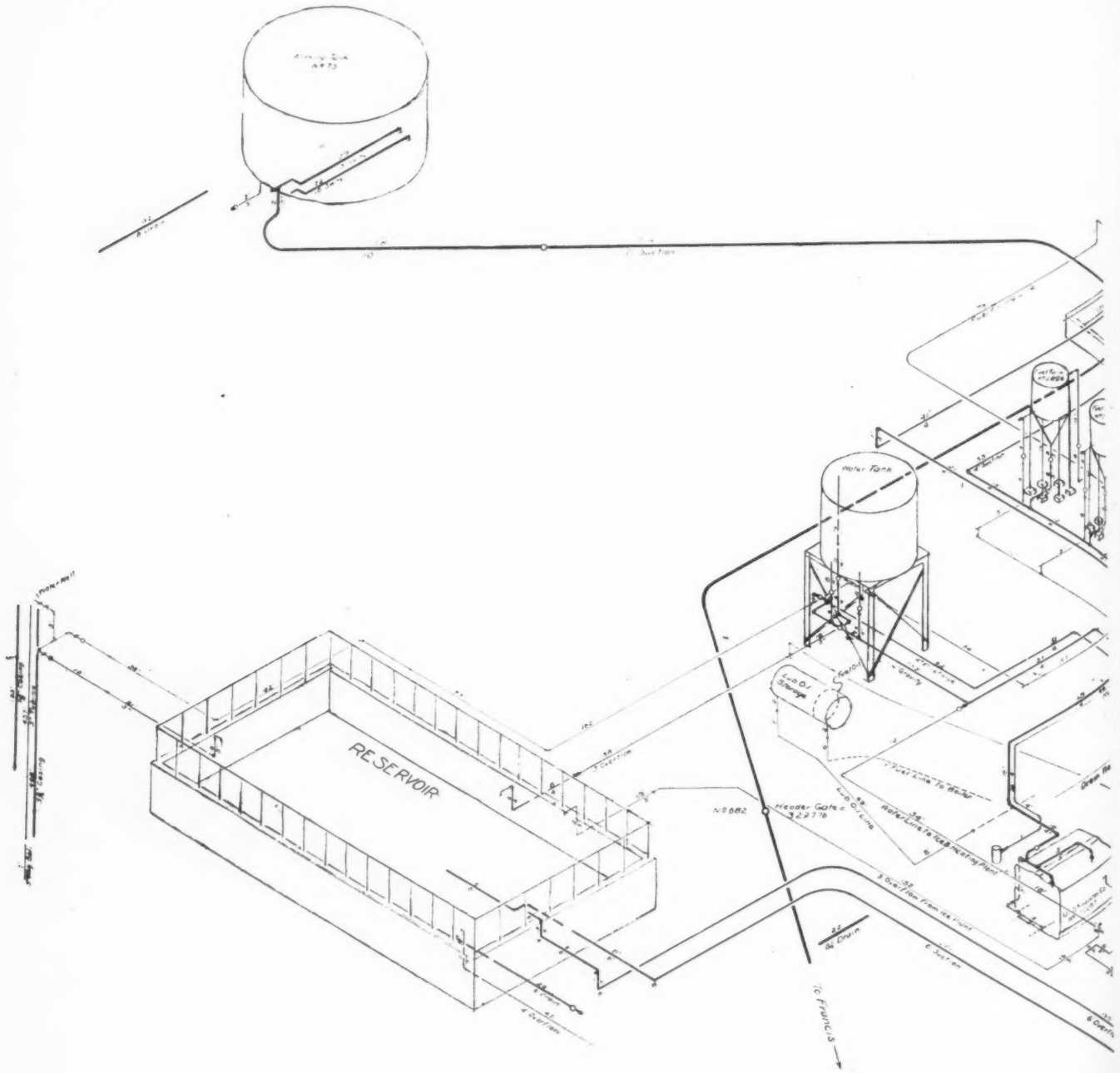
the heating plant is the ice machine to supply the families in the cottages as well as have ice for the station.

By having all lines in conduits and no exposed heating pipes, tripping and stumbling hazards have been eliminated. Wiring is also in conduits. Vapor-proof fixtures have been installed to reduce fire hazards and vapor-proof trouble lamps with 60-foot insulated cables are part of the regular equipment. The hand fire extinguishers are racked closer to the floor than they are generally so that they can be seized more readily. Other fire fighting equipment includes the regular hydrants and hose reels. In the Seminole area, where the company had an extreme fire hazard and had to protect two stations and two storage tanks, a 1,200 barrel capacity generator was built.

For handling heavy bed plates and parts on the engine-room side of the stations, the steel supports are designed to carry 10-ton craneways. In stations where vertical types of engines are used an auxiliary two-ton craneway is carried in the roof trusses for use in pulling pistons.

Both the engine and pump rooms of the stations are kept free of dust and oil mainly because the machinery is made neater with paint. With each piece of equipment in an excellent state of preservation, the station crews have shown more interest in keeping it clean and watching out for and remedying oil leaks. As a rule machinery trouble is discovered when it is a mole hole and prevented from developing into a mountain.

The stations present a much neater interior appearance because all of the floors are painted with a neutral color paint. To protect the paint along the most frequently used paths in servicing and operating machinery, walkways have been made from ordinary roofing material cut in strips 15 inches wide and laid on the floor. These are painted black and give a touch of color making the interior more attractive.



A model main line station plan

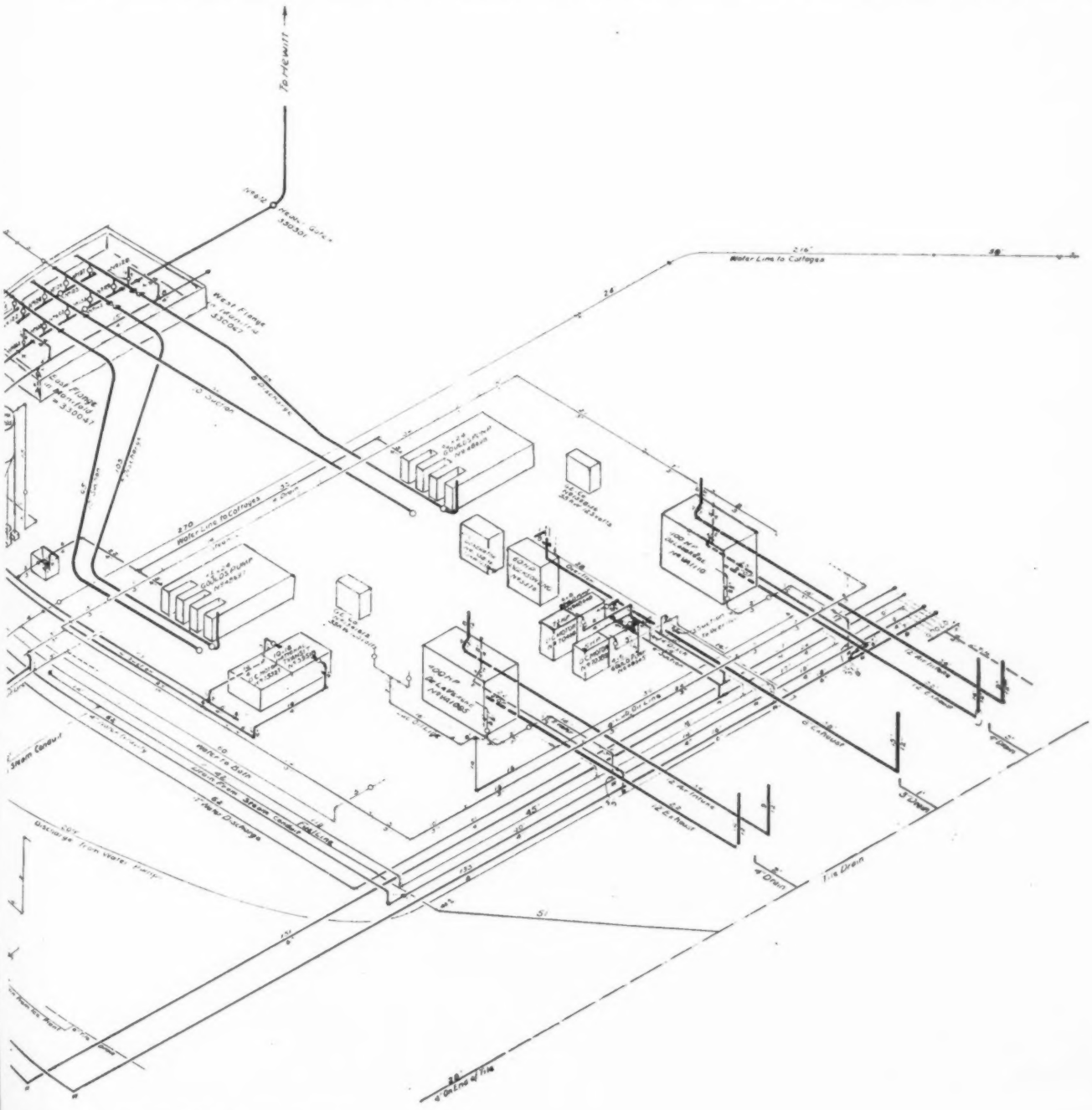
Each station is painted annually. Once each month the district superintendent and the district foreman make a tour of inspection and annually an inspection is made by the officials at the home office in Muskogee.

Each of the main line stations, booster stations and the local gathering stations have working tanks equipped with automatic gauges. Readings from these are taken each hour and while remarkably accurate the tanks are checked twice daily with a steel line. The automatic gauges have eliminated the possibility of an accident happening during the absence of the operator of "one man stations". They do not have to leave their stations while gauging a tank and in the event of trouble arising during the gauging period the operator is at his post to act. The steel line is run during the changing of shifts, leaving an operator at the station while another gauges the tank.

The steady hum of motors at one of the booster stations had the effect of a sleep-producing drug on one operator and it was found that after gauging the working tank he set an alarm clock and took an hour's nap. One day someone slipped into his station while he was asleep and turned his clock up a couple of hours. After waking and noting the time he "burned the wire" sending in a couple of "Boiler-housed" hourly gauges and an alibi about a broken instrument.

Two venerable steam stations are still in operation on the carrier's main line. Both stations have a rated capacity of 60,000 barrels daily and operate with two National Transit Triplex Expansion units at each station. It is as difficult to find oil or steam leaks in these stations as in the more modern. Steam lines have been redesigned and mounted on swings and rollers to care for contraction and expansion. The lines are heavily insulated and are equipped with automatic stop and check valves to protect the workmen while cleaning the 80-horsepower return tubular boilers.

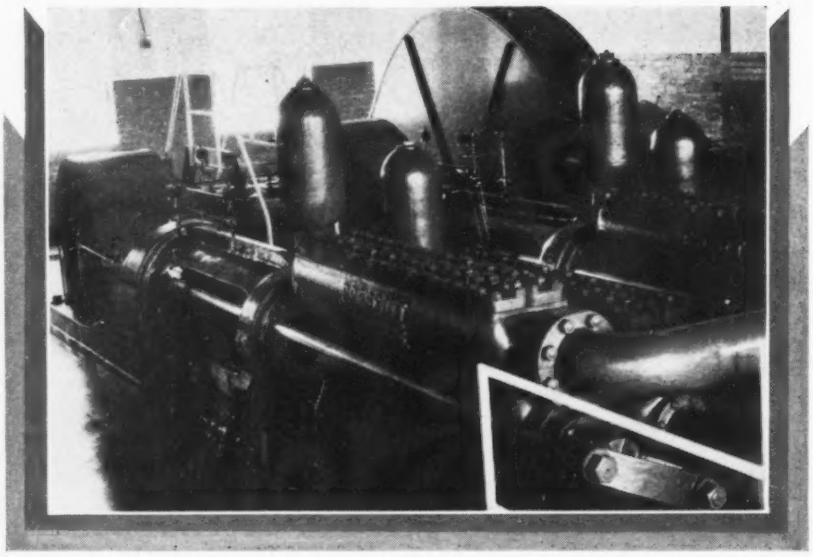
The floors in these stations are painted and those in the boiler houses are spotlessly clean. When a boiler is being



of the Oklahoma Pipe Line system

cleaned the floor is protected with canvas. All brass work is kept highly polished and although the temperature in the engine room rises well above 100 degrees during the summer months it would be a difficult matter to get a member of the crew to ask for a transfer.

Evidence of the march of progress is found at this station where an electric-driven plunger pump was added as an auxiliary unit. When the addition to the building was made it incorporated the improved features in construction without disturbing the elevation of the older building. The 600-horsepower direct connected synchronous motor is push-button control with automatic pressure controls that shut down the motor when pressure varies 20 pounds above or below a predetermined normal.



Motor-driven Prescott pump at the Council Hill station.

The contrast of the relative early area of operation and the relatively new is drawn more sharply at Henryetta station, a 50,000 barrel capacity centrifugal booster station, located half-way between Council Hill and Cromwell stations. It requires less floor space than the motor-driven auxiliary unit at Council Hill, and was one of the first centrifugal booster units installed.

Two 400 horse-power motors, direct connected, drive the two 6x17½ four-stage centrifugal pumps in series which pump through one 10-inch line to Council Hill, a distance of 25.02 miles with a 155-foot fall in elevation. With one unit in operation the pump delivers 1,250 barrels hourly at a pressure of 300 pounds. Operating at a maximum pressure of 610 pounds the two units deliver 2,150 barrels hourly. The station was designed to handle oil of Seminole grade.

Three combination men operate the station in eight-hour shifts. Each man serves as engineer, gauger and telegraph operator. Originally this station was built without a working tank, but later experiences taught that a 5,000-barrel surge tank was the only solution for several troubles that developed. At this station as well as others are to be found the manufactured radius bends to replace the multiple field bends. With this type of bend two welds are required and the bend is 100 per cent salvageable.

Cromwell, one of the newer main line stations, is an initial and gathering station with a rated capacity of 43,600 barrels daily. Two 400 horse-power vertical oil engines drive the 6¼x24 plunger type pumps. When operating at capacity the engines run at a speed of 200 r. p. m. and the pumps do 35.7 r. p. m.

When not connected to a high line generating D. C. power a generator is connected to each oil engine. Each develops 35 kw, 125 volts, 280 amp. direct current and operates at 600/900 r. p. m. These generators supply current to the small motors driving engine cooling water pumps and to the motor driving suction pumps. The suction pump is a 10x18 pump operating at a speed of 34 r. p. m. and driven by a 20 horse-power motor running at 1,150 r. p. m.

In the event of a shutdown an auxiliary oil engine unit drives the generator to supply current for the motor on the suction pump and lights. This engine is a 60 horse-power, two-cylinder, cold-starting, vertical engine driving the same type generator as those hooked to the big Diesels. It operates at a speed of 300 r. p. m.

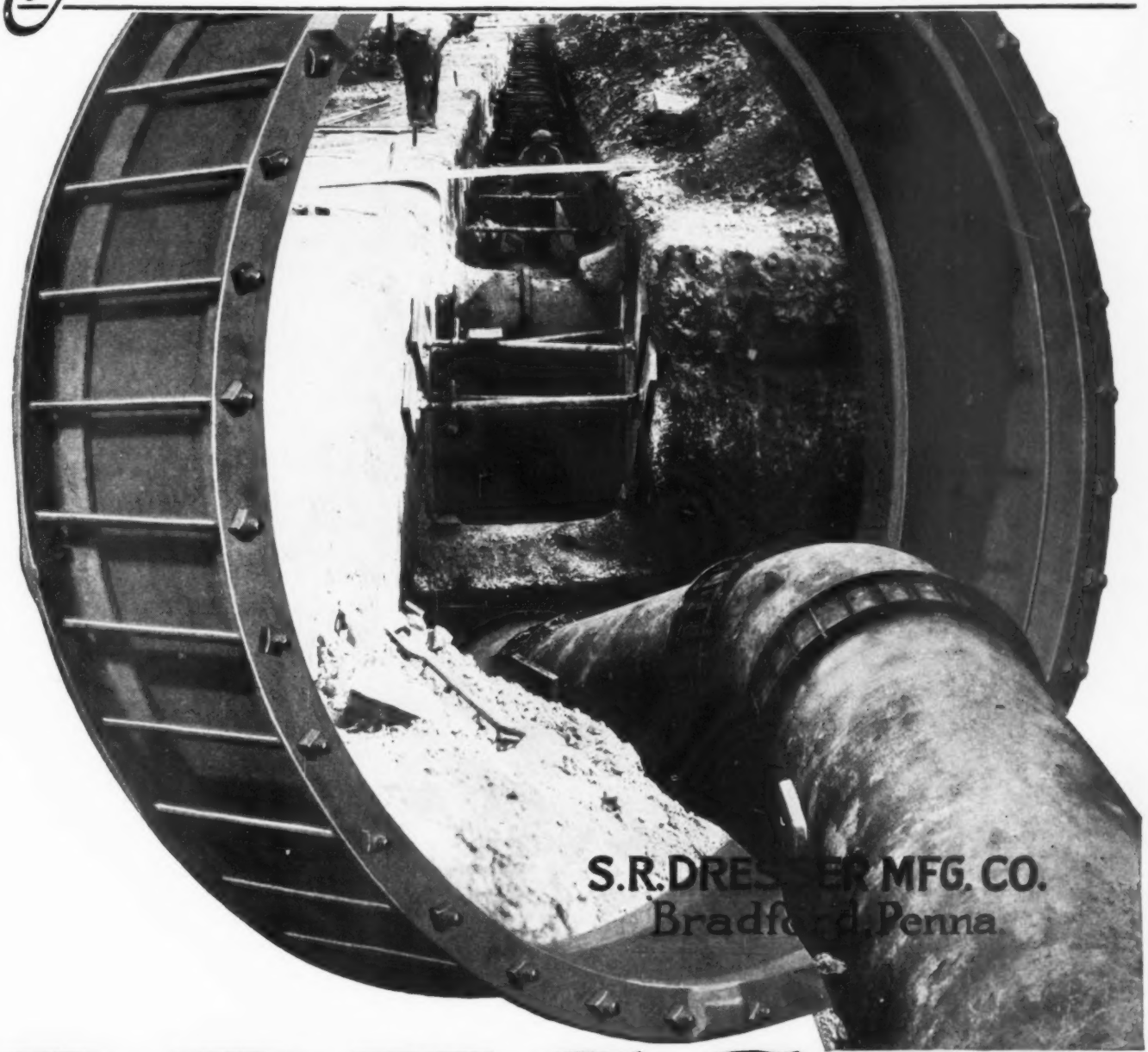
One phase of operation effecting a big savings is the company's plan for the personnel to coin its ideas. Briefly, it is a plan to encourage employes to develop new ideas in operation or in promoting safety. The plan is given a trial at the station to which the employe is attached and if satisfactory results are obtained then it is brought to the attention of a committee of officials who make a final decision on it. If the plan has merit then it is adopted as a standard for all stations and put in operation when practicable.

From this plan approximately 100 ideas have been developed by employes over the entire system. These ideas ranged from devices to improve station operation or cut costs, to devices to further promote safety. In many ways it has effected a savings for the transporter and especially in the salvaging of otherwise junk material.

Very little pipe finds its way to the junk pile until it has been made to serve a great deal longer than its average span of service. All of the small fences, guard rails, etc., have been made with salvaged small diameter pipe welded, and then painted.

St. Louis, Okla., station, showing the radius bends used.

Another Great Achievement



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Modern Trend *in* Petroleum Refining

By F. R. STALEY

MANY new and superior motor oils and greases have appeared on the market during the last year to meet the demands of the new high-speed automobile and aeroplane engine. These lubricants are the result of intensive chemical and mechanical research to improve refining processes and equipment. The technical societies of the country which have studied lubrication and lubricants have established the relative significance of various specifications for motor oils by actual performance and service tests. The constantly increasing amount of scientific information on the lubrication of internal combustion engines is dispelling the doubt among chemists and engineers about the desirable properties of motor oils required for satisfactory operation. As to the subject of greases for gear and spring lubrication, considerable research work is in progress. Conclusive evidence as to the relative merits of lime, soda, aluminum, and lead soap greases has not yet been definitely established.

High-speed driving in the present-day automobile has brought up a problem of excessive oil consumption. At speeds above 50 miles per hour, road tests show that the quantity of oil consumed per mile rapidly increases as compared with slower driving. Tests on the remaining crankcase oil show that the viscosity increases with the oil consumption. This is due to the fact that the more volatile constituents are distilled off. The volatility of a motor oil depends on the crude and the method of refining or blending. The boiling point of a given fraction from a paraffin base oil is higher than that from a naphthene base oil having the same viscosity. By proper fractionation the volatility of an oil of a given viscosity can be reduced to a minimum by completely separating the more volatile constituents. The older method consists of rerunning the oil in a still after blending the neutral and bright stock. Recently vacuum pipe stills equipped with fractionating towers are being used. In the case of blended oils, the volatility can be reduced by using a higher viscosity neutral with bright stock. A 300 viscosity Saybolt at 100° F. is used instead of 180 or 200 viscosity.

The extent of the decomposition of an oil in service by heat and oxidation with the formation of carbon and crankcase sludge depends upon the type of crude and the refining process. The carbon residue test indicates the carbon-forming tendency of an oil. Naphthene base and overhead oils have lower carbon residue than paraffin base oils refined from bright stocks and residual oils. By acid treating and filtration, carbon residue on an oil can be reduced to a certain minimum which is characteristic of the crude. Additional refining beyond this point only destroys viscous lubricating bodies.

The subject of crankcase dilution is important, especially in winter, when the choke is extensively used. The quantity depends upon the type of oil, the operating conditions of the engine, and whether or not the car is equipped with a ventilator on the crankcase. An oil having too high a viscosity or pour point makes the use of the choke necessary so frequently that in certain cases where a car is often started in winter weather the oil in the crankcase may be diluted to an unsafe degree. It is important that an oil of too high viscosity is not used in winter.

Viscosity and Temperature

According to the American Society of Testing Materials, viscosity is the most important single property of a lubricating oil. This property changes with the temperature, and the rate of change is very different with different types of oil. Since the automobile or aeroplane engine is started and operated over a wide temperature range, a desirable oil should show a minimum change of viscosity with temperature. The viscosity of the oil at the starting temperature and, to a lesser extent, the pour point, determine the starting effort required in winter weather (Wilkens, Oak, and Barnard, *S. A. E. Journal*, Feb., 1928). The viscosity temperature curve of an oil is usually shown by plotting viscosity units against temperature on logarithmic paper, which is approximately a straight line. The slope of this line is the rate of change of viscosity. The specifications for motor oils sometimes state a maximum allowable ratio of the Saybolt viscosity at 100° F. to that at 210° F. which would determine the slope of the line.

The viscosity temperature change of a motor oil depends largely upon the type of crude from which it is refined. Paraffin base oils show the least change, and naphthene base oils the greatest. Recently highly refined oils have been manufactured from fractions of mixed base crudes which appear to possess all the properties of Pennsylvania oils. They are prepared by fractional distillation of selected crudes and then highly treating and filtering these fractions. In order to produce oils having a flat viscosity temperature curve from mixed base crudes many methods of refining are being tried, but as yet none appears to be wholly successful. The change in viscosity with temperature is characteristic of the kinds of hydrocarbon molecules present in the oil.

The various methods that have been tried by refiners to flatten the viscosity temperature curves of motor oils include vacuum distillation, sulphur dioxide and sulphuric acid treatment, aluminum chloride, and selective solvents. When fractions possessing such characteristics are present in the crude it is possible to separate them or remove the objectionable impurities by refining methods, but the molecular structure is not changed. In the case of naphthene base oils they are very often blended with paraffin base bright stocks to flatten the curve.

Dewaxed Paraffin Base Oils

Much attention has been given to dewaxing paraffin base motor oils during recent years to produce zero pour tests. Paraffin wax has no lubricating value and gives the oil a high cold test. Many refineries have installed new equipment to dewax their oils. The old process of cold settling to produce bright stocks of 35 to 45 degree pour point has been almost entirely replaced by the centrifuge machine or the filter press using a filter aid. A solution containing about 60 to 80 per cent naphtha is chilled to subzero temperatures, from minus ten to twenty, with brine coils; or when oils of pour points below zero are desired, the solution is chilled by direct ammonia expansion to minus forty or fifty degrees F. The wax is precipitated from the solution at this temperature and is removed by the centrifuge or a filter press using a special filter aid to retain the wax. In the latter case the wax is washed out by solution in naphtha and the filter aid is ready for reuse. In order to effect a more complete precipitation of the wax, other solvents than petroleum naphtha are sometimes used. These include the ketones, the higher alcohols, coal tar solvents, and others. Due to the high price of these products, their use is still limited. However, they show certain advantages and a more extensive use will tend to lower the price with quantity production.

Grease Manufacture

Much study has been given to the manufacture of greases for automobile lubrication and for the rocker arms of aeroplane engines. Whether heavy mineral oils or greases are more suitable for transmission and differential gears has not yet been definitely demonstrated. While lime soap greases are most widely used in cups and pressure systems, aluminum and lead soap greases are gaining in popularity. Aluminum soap greases have certain advantages over lime greases. Some authorities claim that they have better lubricating properties than either lime or soda soap greases. They are usually transparent and for this reason are often called solidified oils. The soap content is usually lower than that of lime greases, being about 10 per cent, as against 18 or 20 per cent for the latter. Aluminum soap greases usually contain the oleate or the stearate or a mixture of the two. The two compounds give the grease different properties. The oleate produces a softer, stringier consistency than the stearate. These greases are made by the solution of the aluminum soap in the oil at 300 to 350 degrees F. with constant stirring, or by making a soda soap from caustic and fat, then displacing the sodium with aluminum, using sodium sulphate or commercial alum. One of the problems in the manufacture of aluminum greases is to prevent the formation of lumps in cooling. This can be overcome by controlling the rate of cooling and by insuring the proper or complete solution of the soap in the oil, which may be controlled by the time and temperature regulation with constant agitation.

Lead soap greases are usually prepared from litharge and fatty acids. They are said to be the best lubricants for steering worm and gear lubrication. As yet lead greases are not exclusively used except for special applications, although their popularity seems to be increasing.

Lime and soda soap greases are by far the most widely manufactured. They can be prepared by the saponification of a vegetable or animal fat or fatty acid. For pressure gun lubricant or cup grease a 100 viscosity pale oil is usually used, and sometimes a heavier oil. Some authorities claim that there is no advantage in the use of a heavier oil for cup grease from the standpoint of oiliness or friction reduction. Gear compounds are usually made by thickening a cylinder stock or reduced crude with 3 or 5 per cent of soda soap, the latter being better than lime soap.

Through the co-operation of the chemist and the mechanical research engineer, the problems involved in the lubrication of the new automobile and aeroplane engines are being solved by both laboratory and performance tests. The results of such work establish the most desirable properties of lubricants, which information has enabled the refiner to improve his products. Most of the larger refineries are represented in the national technical societies and the exchange of information greatly benefits the whole industry and ultimately supplies the consumer with constantly improved products. Progress in the automotive and aviation industries has been so rapid that the petroleum refiner must co-operate with them to the fullest extent.

Although the properties of the finished motor oil depend almost entirely upon the type of crude oil from which it is refined, the refiner finds it necessary to produce the ultimate quality product from his oil. Oils can be manufactured from selected mixed base crudes that appear to possess all the properties of the highest grade paraffin base oils. Present refining methods consist in separating certain fractions and removing objectionable impurities with chemicals or clay from the lubricating oil and not in changing the structure of the hydrocarbon molecule. The physical and chemical properties of the refined motor oil depend upon the type of hydrocarbon molecule present.

Many new types of equipment have been installed to manufacture the new motor oils. The old shell still is being rapidly replaced with the single flash pipe still equipped with a fractioning tower operated at atmospheric pressure or under vacuum. This type of equipment produces an oil of minimum volatility, and when used on mixed base crudes to produce overhead bright stocks, greatly reduces the acid necessary for treatment and the sludge formation.

The old cold settling process was so inefficient in removing wax that it has been almost entirely replaced by the centrifuge for dewaxing bright stocks and long residiums. A more extensive use of solvents in the precipitation of wax will no doubt become more widely used.

Sulphuric acid treatment is as yet almost universally used in refining mixed base lubricating oils. The use of sulphur dioxide and aluminum chloride as refining chemicals is being studied by some refiners and presents possibilities on certain oils. On heavy cylinder stocks they do appear to be as effective as concentrated sulphuric acid in removing asphaltic compounds.

On acid-treated oils, clay neutralization or contact filtration has a decided advantage over chemical neutralization and percolation. The revivification of fine clays still presents some mechanical problems, although it is possible to obtain a 90 per cent efficiency by burning at temperatures below 1000° F. Where the clay is not recovered, the use of a highly efficient clay makes the process economical by reducing the consumption to a minimum.

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BETTER BE SAFE GUIBERSON THAN SORRY

Some Outstanding Examples of
Crooked Hole Drilling

THE subject of crooked holes has attracted so much attention from the petroleum industry during the past three years, that it is strange it has not found its way into the columns of "Rip", who created the daily news feature "Believe it or not." There are innumerable features connected with the crooked hole problem which might well be incorporated into Rip's column, for the crooked hole problem has caused some conditions which are extremely hard to imagine.

One of the outstanding examples of how wells should not be drilled is portrayed in the long illustration accompanying this story. It is a well in a field of Oklahoma, and for obvious reasons the identity is not given.

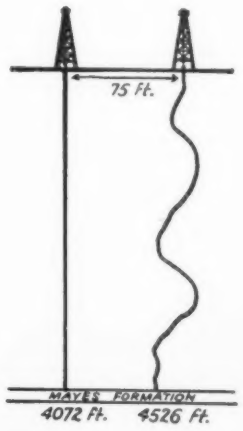
The well was started in company with other wells in this pool with the Wilcox sand as a destination. The producing horizon was expected at a depth of about 4,400 feet. The present depth of the well is 5,000 feet, and it has been producing for several months.

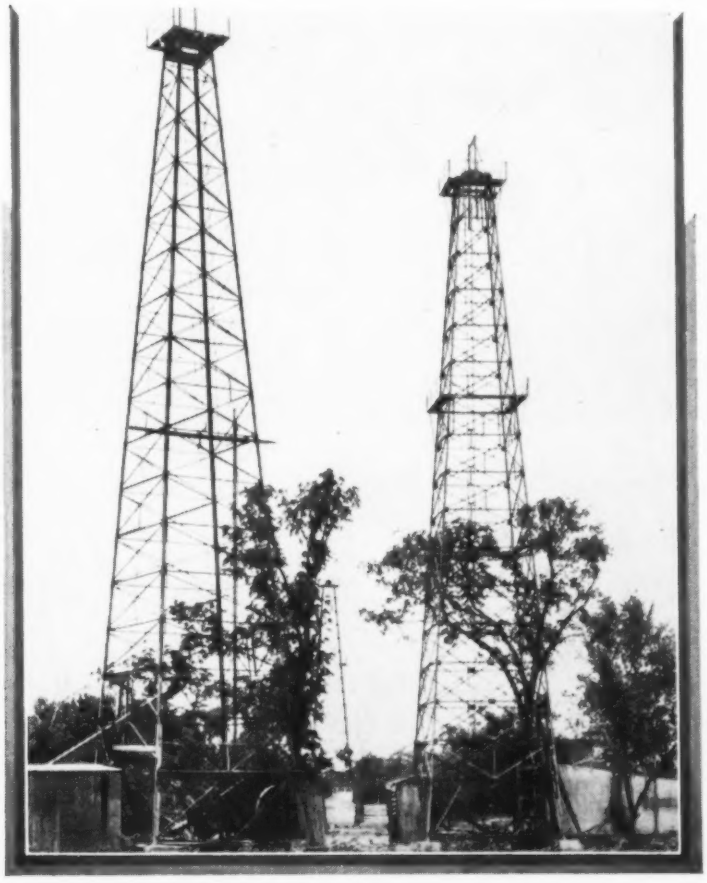
It started off with a small natural flow, which rapidly declined, and then the air-gas lift was installed. After several months of this form of production, the well was put on the pump, and when some mechanical difficulties were experienced, the acid bottle method of surveying the course of the well was used.

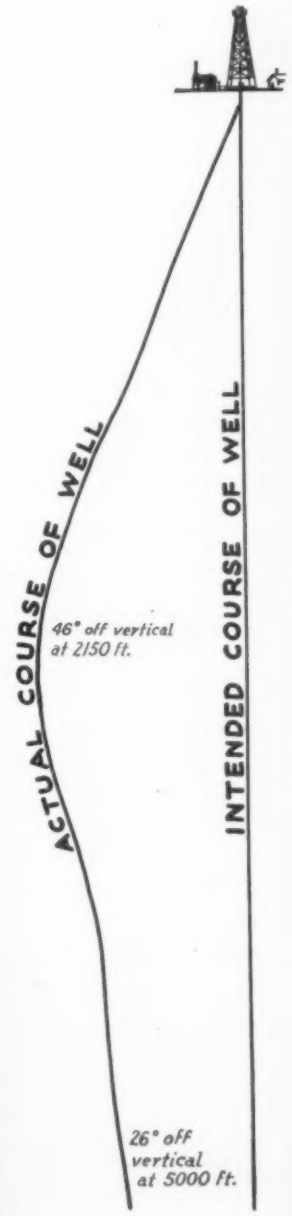
The results of the acid bottle may be scrutinized by an examination of the drawing accompanying this story. The hole is far from the vertical. Its maximum deviation is found at a depth of 2,150 feet, at which point it was 46 degrees off vertical. From that point it swung back to the intended course of the well, and at the bottom of the hole it was found to be 26 degrees off vertical. At the point of its greatest deviation from the vertical, the well is calculated to be 2,300 feet away from the course which it was intended to pursue.

The remarkable part of this story is that the well has been pumping for many weeks without any mechanical trouble, and that is where Mr. Ripley might enter into the picture.

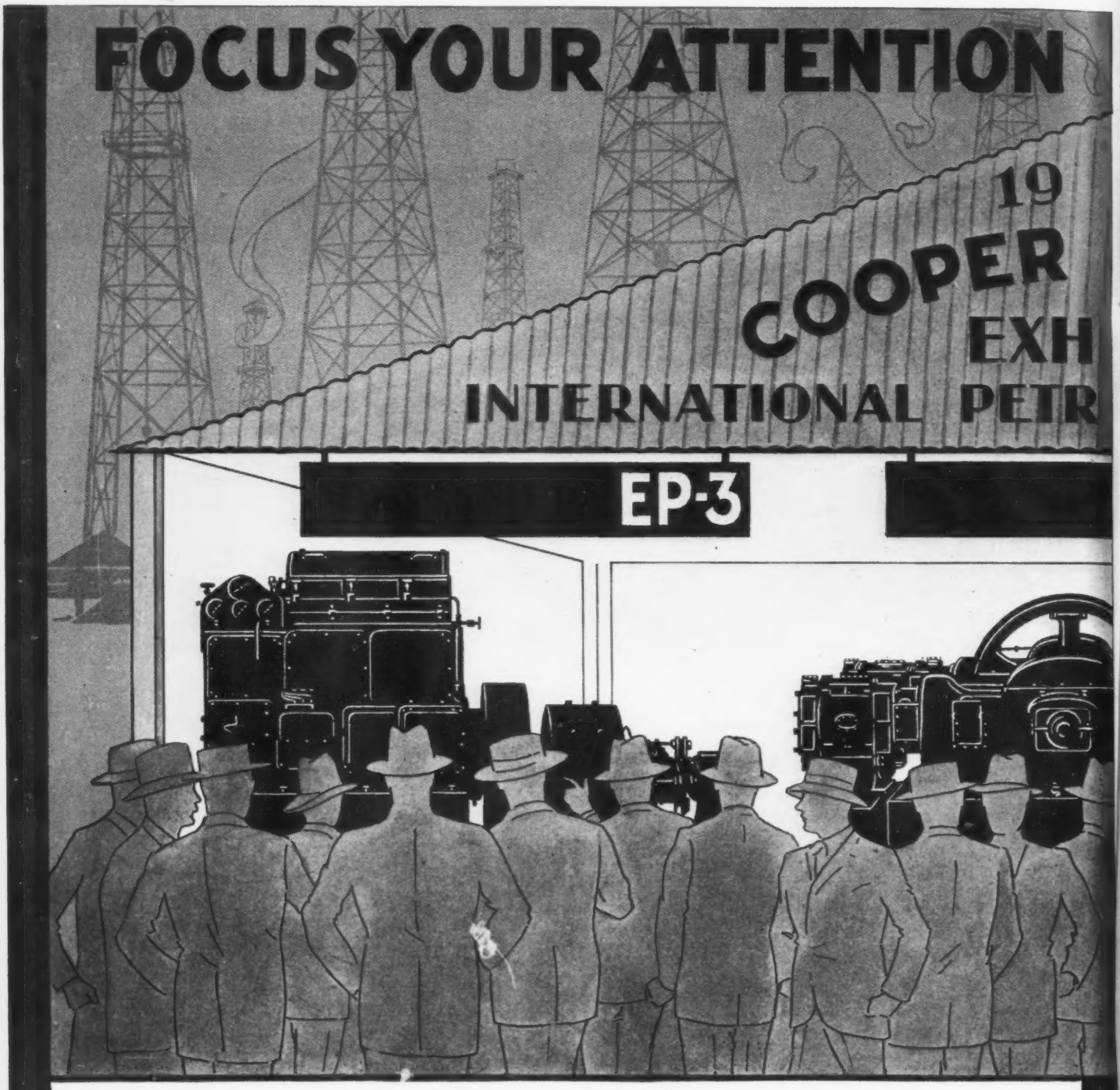
The smaller drawing accompanying this story illustrates another instance of crooked holes in Oklahoma. This was on a wildcat well. The well was drilled to the Mayes lime formation which was expected at a depth of 4,100 feet, but which was actually encountered at a depth of 4,525 feet. Some fishing troubles were experienced at this depth and the rig was finally skidded. A new hole was started, and the course of this hole was presumably straight, for the Mayes lime was found at a depth of 4,072 feet. The rig was skidded a distance of only 75 feet.







Left—Straight drilling makes big difference where you find a formation. Center—A line fight in the Seminole field. Right—Although very crooked, this well pumped eight weeks without pulling.



THE engines chosen for exhibit this year represent three of the important phases of gas and oil field engine service.

Bessemer Type-OF engines have been one of the leaders in pumping and drilling work. The new type on display, however, is radically different from the one so well known. Because of the many improvements it was necessary to change the design itself.

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Nearly as important as the main engines, are the auxiliary power units. The dependable performance of Bessemer Type-EP-3's has established their reputation for this service. The engine, which is a full Diesel, direct drives the electric generator. This unit will be new to many oil and gas field men.

There will be many interesting exhibits at the exposition but few will have the focus of attention of these improved engines.

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NOTE the bend made to go over ledge — a hot bend made in the field. You can cold bend or hot bend Naylor Pipe right on the job, without damage to the structure.
Naylor Pipe vacuum line carrying casing head gas in Oklahoma. 40 ft. lengths, 10 in. diameter.
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Standardized Naylor Pipe is made in sizes 4" to 12" in standard 20 ft. lengths or special lengths up to 40 ft. Made with 5 types of pipe ends to wrought pipe standards for 5 types of joints.
Where corrosion resistance is not a factor, Naylor Pipe can be furnished in steel.
Toncan Copper Molybdenum Iron is a development of Central Alloy Steel Corporation, the world's largest and most highly specialized alloy steel producers. It possesses a superior corrosion resistance, making it the favored pipe material.

Current Problems *of the* Natural Gasoline Industry

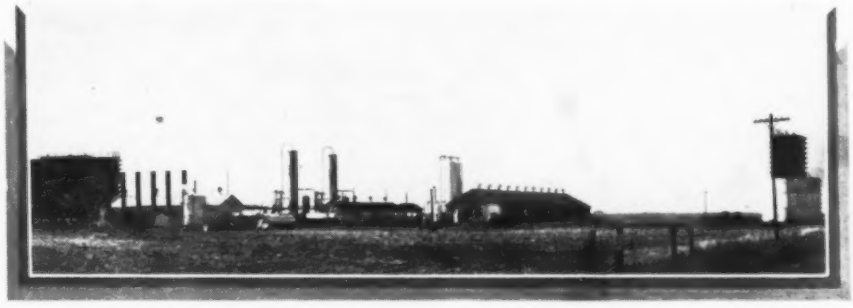
By EMBY KAYE,

General Superintendent Skelly Oil Co., Natural Gasoline Department

THE natural gasoline industry is casting about among sister industries for relief from a ponderous problem created by carrying efficiency too far. It seeks an outlet for its lighter constituents for direct use as a fuel or a means for the conversion of its excess butanes into higher boiling hydrocarbons. That means must, of course, be practical and economic.

The writer wishes at this time to discuss only the economic aspects of the problem and its solution and to invite technical discussions. While a few companies in the natural gasoline industry have been seriously at work on this problem and have expended large sums of money in experimental development and commercial exploitation, it appears that the industry at large has been prone to regard the problem as belonging to, and affecting, only a small group, and have therefore not been alive to its possibilities, on the one hand, and of its relation to the oil business as a whole, on the other.

One needs only to point out a few statistics to show that the task ahead is something of major proportions. It has recently been estimated by an eminent investigator that there is available at the present time in this country some 40,000,000 barrels or 1,680,000,000 gallons of butane per annum, or 4,600,000 gallons per diem. While this figure may be justified, the writer believes that 4,000,000 gallons daily can easily be accounted for as follows: 1,800,000 gallons produced and saved as natural gasoline by gasoline plants; 1,200,000 gallons produced or available for extraction but not now saved, and possibly 1,000,000 gallons at refineries.



Skelly Oil Co.'s natural gasoline plant at Kings Mill, Texas.

Fundamentally, the price of motor fuel, as well as natural gasoline, is a reflection of the supply and demand of these commodities, subject, of course, to the general principle that the price of natural gasoline must remain reasonably close to the price of motor fuels. At the present time the refiner is the major buyer of naturals and, while he bends every effort to keep the price of this raw material down, he has learned that it is unhealthy for the price structure of his own commodities unduly to depress naturals. The history of the past three or four years shows that a prolonged depression of prices for natural gasoline has had a definite tendency to "bear" the refinery market.

The refinery output of motor gasolines has of late been more or less controlled by something approaching an intelligent regard for the demand for these products. If respect for this demand were universal, the price of gasoline could be based upon manufacturing cost plus a reasonable profit and raw materials could be stored against increased demand. But, as it is well known, the raw materials from which natural gasoline is derived, cannot be stored. If the gasoline vapors in natural gas systems and in the gas produced from oil wells are not recovered when produced, they are lost forever. Hence, they are recovered almost without regard to the value of the gasoline or its need as a component of motor fuel. It would appear to be good conservation to recover this material.

Once recovered, the raw material is partially stabilized and is available for the market as one or another of the several grades of natural gasoline. In this condition, due to its volatility, it cannot be stored except at unusual expense. Only the very large manufacturers have any storage over working storage. A situation is thus created that throws some five to six million gallons of material on the market each day. It is true that a great deal of this volume finds its way to contract buyers, and that another large portion of this production is kept out of the channels of trade by its use by those refiners who also produce natural gasoline through other divisions of their companies, but, nevertheless, a sufficiently large amount of naturals comes daily to the market which now and again has "beared" the whole gasoline market.

Present grades of natural gasoline and A. S. T. M. testing methods for this material have encouraged the packing of high percentages of butane into the various grades. While many refiners buy natural gasoline for volatility, and while volatility is the function of butane, other refiners use naturals for reasons other than volatility. It is more than likely that the revision of natural gasoline specifications, if and when such revision is made, will take volatility and butane content very much into account. For the nonce, we know that for certain purposes a debutanized natural gasoline is more valuable than one of the regularly graded naturals, and, "by rule of thumb," it is assumed that a debutanized material is worth 35% more than "AA". Since there is no definite market for butane (at least there is none as far as production possibilities go) the manufacturer will debutanize his "AA" only if he can receive full compensation for the loss of his butanes and make a little showing for his added costs for manufacturing. Incidentally, this is the only condition when the manufacturer is not subject to "market price." He has an opportunity to take costs into consideration, and if the sales manager cannot obtain the price, he simply does not offer a debutanized product.

It is entirely possible that a 35% differential on this product is too wide. For the moment, however, it is essential that such a price structure be maintained. When an outlet for

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The manufacturers of Nordstrom Valves seek a new slogan pertaining to these valves... a slogan that will suggest the service or function, features or advantages... or some easily remembered phrase that will identify the excellence of Nordstrom Valve service. ¶ The slogan..."**Won't leak...Won't Stick**"... is now used, but there are so many outstanding features of Nordstrom Valves with which you are familiar that surely you can think of several good slogans. Your plant engineer may have some suggestions to offer too! ¶ If desired we will send a catalogue describing the various features of Nordstrom Valves which may give you a clue to a master slogan. ¶ You have 19 good chances to win a cash prize. "Think up" a slogan now. Send it in. Send us more slogans as they occur to you. But start now!

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4 Prizes, each . .	10.00
12 Prizes, each . .	5.00
TOTAL 19 CASH PRIZES	$500.00

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Slogan must not exceed 10 words. Any number of slogans may be submitted by same person. Use coupon below or separate sheet of paper. Contest closes December 31, 1929.

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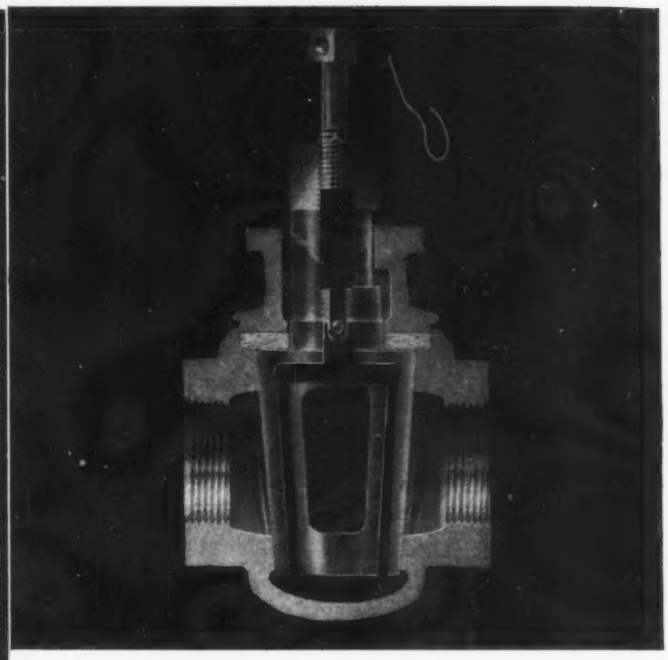

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NORDSTROM VALVES are of the plug cock type, with lubrication and lifting features that make them easy and sure of operation. A stick of special "Merco" Lubricant is inserted under the lubricant screw. The latter, when turned, forces the lubricant down and around the plug. Fluid or other material within the line cannot pass around the plug and leak out, or lodge in the seat. The plug is always easy to turn. Made in types and sizes to meet conditions in all industries.

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2, 3 and 4-way types.
For high or low pressures.
For high or low temperatures.
Special lubricant for special conditions.
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butane is developed, that differential can be reduced to an extent approaching the net income derived from the sale of butane, although that reduction need not be carried out to its ultimate possibilities. For the present a manufacturer will not debutanize unless he gets his price for the super-stable product and has an outlet for his light fractions. This is particularly true if he can manage in some manner to dispose of his gasoline as a regularly graded material.

By the very nature of the extraction processes and the physical laws involved, a large proportion of the butane and lighter fractions that are recovered in treating a gas containing gasoline vapors are recovered incidental to the extraction of the heavier constituents. Recent designs of plants have anticipated high butane recoveries as the need or market for butane is found, while today's operations quite often involve the extraction of only 50% of the available butane, a part of which even then is cut out of the raw product by rectification, so that only that percentage of butane and propane remain as will leave the finished product within the specifications of one of the marketable grades of natural gasoline.

The work done thus far indicates that the outlet for butane will be not as a chemical material, at least not in the immediate future, but in the channels of fuel. Certainly a major portion of the production will continue to go directly into motor fuel to give to that fuel the degree of volatility desired by the manufacturer, as well as to increase the anti-knock rating of that fuel. An increasing volume will go to the bottled gas industry. With certain classes of equipment, where the fuel is not vaporized until it reaches the vicinity of the burner, butane is a gaseous fuel of an exceedingly high B. t. u. value. In climates where the minimum temperature is seldom below 35° F., this gas will find a good market. But, at best, only a small volume of butane proportionately can be absorbed by this new and growing business.

Phillips Petroleum Co's natural gasoline plant at McCamey, Texas.

There is opening an avenue for butane disposition that justifies the hope of a major market and a possible solution to the whole vexing problem. Experiments on a semi-commercial scale indicate that butane may be used as a source of domestic gas and may be supplied to industries and communities in the same manner that manufactured gas is now supplied. This may be done by mixing the gas with air, or by the partial combustion and cracking of the raw material, the purpose in either case being to reduce the B. t. u. of the butane from 3275 to 550 or whatever is desired by the particular industry. The use of butane direct, where heat control and purity of gas is important in processing, such as hardening, carbureting, core baking, cutting, annealing, sanitary ware, glass, etc., has been furthered by one large natural gasoline manufacturer and such uses are now established practice in a number of plants.

The conversion of butane into low B. t. u. gases by partial combustion offers perhaps the most inviting prospects because of the almost unlimited market for the reformed gases, on the one hand, and the possibilities of valuable by-products, on the other. It has been demonstrated that the recovery of benzol, tar rich in anthracite content, tuluol, xylol, etc., may very well be as important economically as the conversion of gas for fuel purposes. While efforts are under way to establish butane cracking in the field for these by-products, with an eye possibly to the use of the residual gases for gasoline plant uses, it would appear that it might be more advantageous to plan ultimately to locate the "cracker" at a point where a market for the converted gases was available. At present it appears that it will require the disposal of both residual gases and by-products to make a favorable showing. If, as, and when a suitable catalytic agent is found to convert a larger amount of the butane into by-products, it is reasonable to expect that cracking for by-products only may be justified.

On the basis of only 1,000,000 gallons of butane daily, representing a conservative gallonage that can readily be diverted from present channels or from what is lost in transportation or burned at recovery plants because it is available in quantities in excess of requirements for disposal in standard grades of natural gasoline, a twenty million dollar gross income is possible. As the market is developed further, diversion of butane can and will be made that will result in diminishing the amount of butane-packed natural gasoline on the market, increase the value of the super-stabilized fuel, and broaden the market for these products, and, at the same time, open a new source of revenue to the manufacturer of this product.

With these objects clearly defined, can the industry afford to expend the money and effort required to give impetus to the development of processes that will provide the by-product materials for which there is a ready market, and, to the development of a market for residual gases, which can be opened by study and education and demonstration?

This is a problem to which the combined efforts of the natural gasoline industry may well be dedicated.

AN IMPROVED type of spring casing hook embodying time-proven principles and offering improved features has been developed by Regan Forge and Engineering Co. It is made of alloy steel, heat-treated, with the hook bored out. Special attention has been given to the design of the hook. The hook has considerably more cross-sectional area of metal and much greater weight to handle the heaviest loads. For several months the experimental hooks of this design have been in operation in California, used on the world's deepest well and several score of other very deep wells, and has proven extremely satisfactory, according to the manufacturers and drillers.

Control *of* Water-Cement Ratios in Oil Well Cementing

By C. P. PARSONS,
Duncan, Oklahoma

THERE is a trend in the technical field towards the subject of water-cement ratios. The clearest contribution of thought along that line, and which can bear repeating, is the water-cement ratio strength law stated by the Portland Cement Association, as follows:

> "For given materials and conditions of manipulation, the strength of concrete is determined solely by the ratio of the volume of mixing water to the volume of cement so long as the mixture is plastic and workable."

To apply that law to neat cement, as used in oil well cementing, it might be stated that for given conditions of manipulation the strength of neat cement is determined by the ratio of the volume of mixing water to the volume of cement so long as the mixture is plastic and workable. Which means that *after* considering the size, shape and condition of the space in which the cement has to be placed in the hole or behind the casing and the physical requirements imposed on the cement on its long travel to its proper place, then determine the lowest suitable water-cement ratio.

A good average water-cement ratio for oil well cementing is around 4½ gallons of water to a sack of cement. This will make a neat cement weighing a little over 16 pounds per gallon, varying a little with different cements.

Table No. 1, accompanying this article, shows the weight of neat cement mixed with various water-cement ratios. This table is very handy in the field for determining ratios. One simple way to determine ratios is to weigh a gallon of mixed cement and then refer to the table.

TABLE 1.
Water-Cement Ratios of Neat Cement.

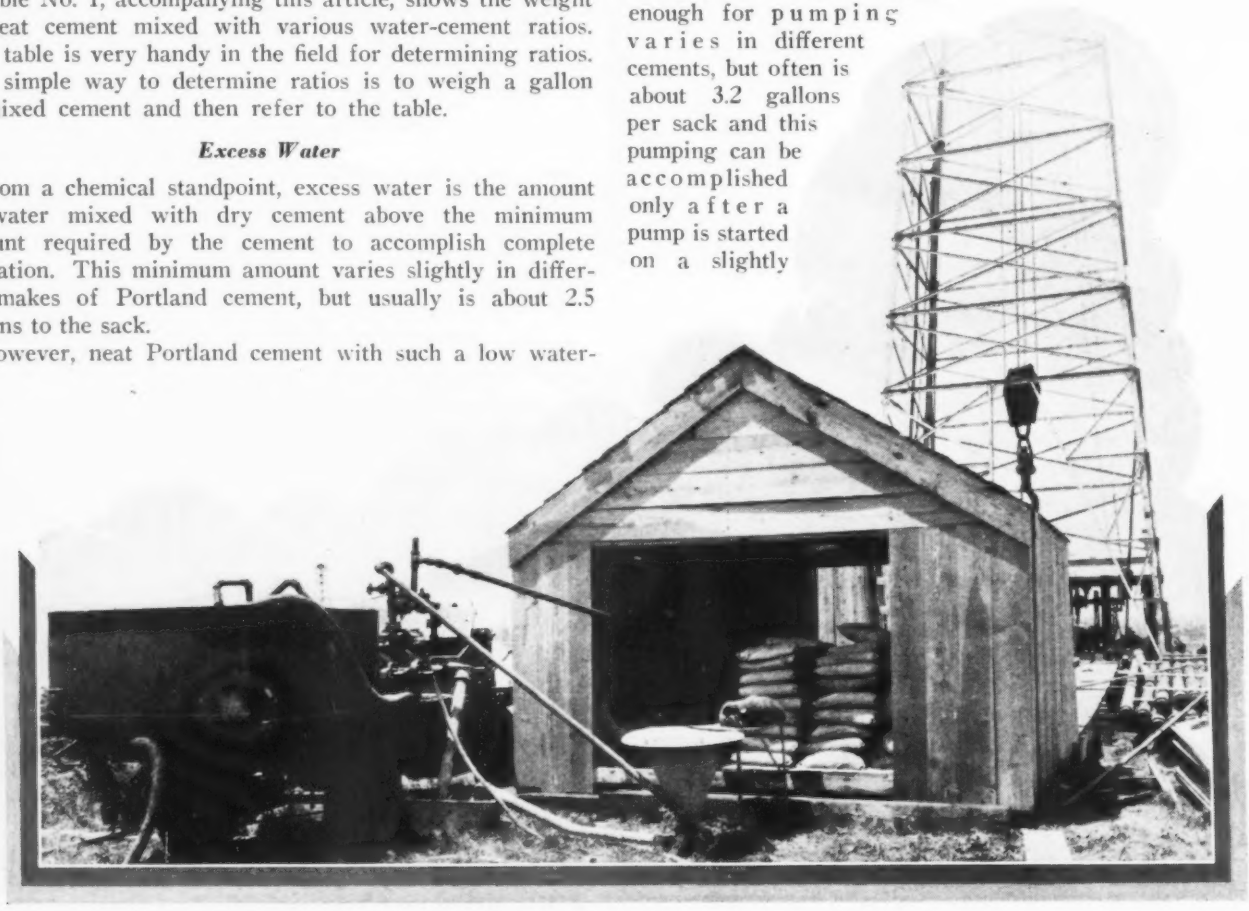
Before Mixing				After Mixing
Ratio in gallons of water per sack of cement	Equivalent ratio in decimals (Ratio of water by volume to sack of cement)	Equivalent ratio in percentage of water by volume to sack of cement	Equivalent ratio in percentage of water by weight to sack of cement	Weight per gallon of cement mixture (based on cement with absolute volume of .48)
7½	1.00	100%	66.2%	14.0
7	.933	93.3%	61.8%	14.3
6½	.867	86.7%	57.4%	14.6
6	.80	80%	53.0%	14.9
5½	.733	73.3%	48.6%	15.3
5	.667	66.7%	44.1%	15.7
4½	.60	60%	39.7%	16.2
4	.533	53.3%	35.3%	16.7
3½	.467	46.7%	30.9%	17.3
3	.40	40%	26.5%	18.0

Excess Water

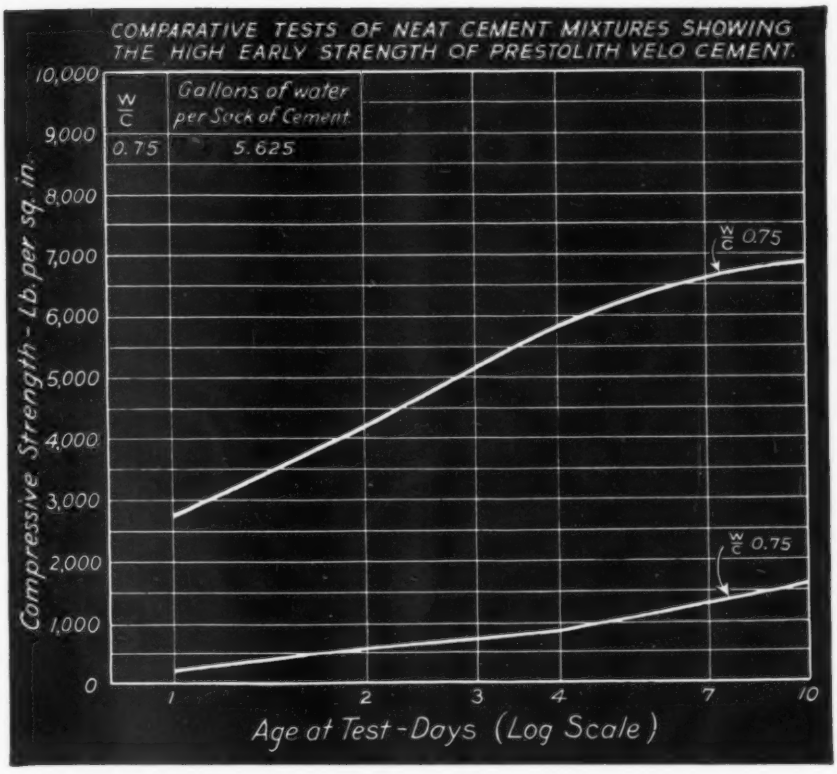
From a chemical standpoint, excess water is the amount of water mixed with dry cement above the minimum amount required by the cement to accomplish complete hydration. This minimum amount varies slightly in different makes of Portland cement, but usually is about 2.5 gallons to the sack.

However, neat Portland cement with such a low water-cement ratio is very difficult to mix, even in small quantities, and is not plastic and workable enough for any cementing operation that requires pouring or pumping, even in surface work.

The minimum amount of water necessary to make neat Portland cement workable enough for pumping varies in different cements, but often is about 3.2 gallons per sack and this pumping can be accomplished only after a pump is started on a slightly



Ready to start mixing it up with a Halliburton cementing outfit.



This curve represents Prestolith Velo Cement strengths taken from tests made by the Prospect Hill Laboratory of the Missouri Portland Cement Company.

$$\frac{W}{C} = 0.75$$

This curve represents Portland Cement strengths taken from an article appearing in the January 19, 1928 issue of Oil and Gas Journal and reproduced through their courtesy.

$$\frac{W}{C} = 0.75$$

CEMENT YOUR WELLS WITH

Prestolith VELO CEMENT

BRAND REG. U.S. PAT. OFF.

When the Joe S. Williams No. 3, Logan County, Oklahoma, owned by the Wentz Oil Corporation, was cemented, Prestolith Velo Cement was used.

With the Halliburton process and 2 Halliburton machines, 1200 sacks of Prestolith Velo were placed in this 4785-foot hole in the record time of 50 MINUTES.

Performance records such as this with dependable 24 hour strengths have established Prestolith Velo as the perfect oil well cement.

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Manufacturers of Red Ring Portland Cement for more than a quarter of a century. Write for complete literature.

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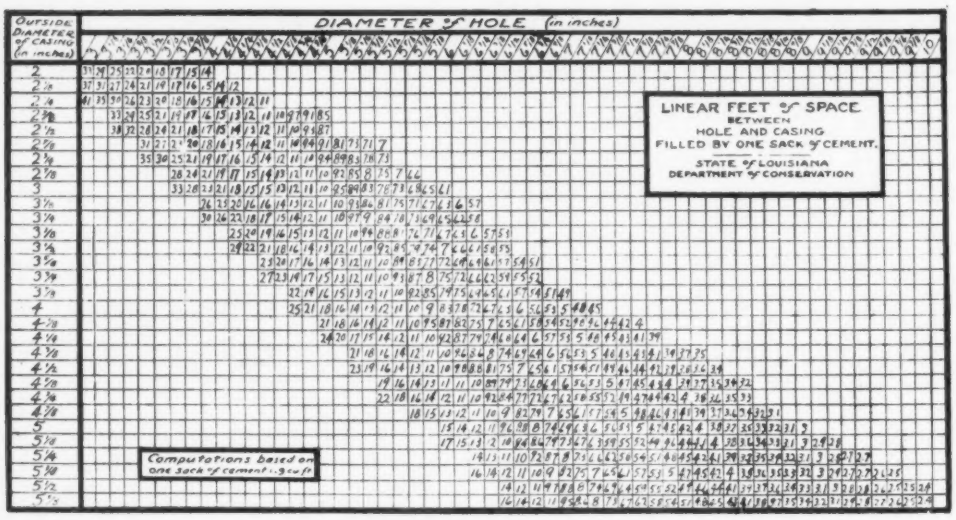

DIAMETER of HOLE (in inches)
OUTSIDE DIAMETER of CASING (in inches)
LINEAR FEET of SPACE BETWEEN HOLE AND CASING FILLED BY ONE SACK of CEMENT.
STATE of LOUISIANA DEPARTMENT of CONSERVATION
Computations based on one Sack of cement - 94 cu ft

higher water-cement ratio and the ratio then gradually lowered to the minimum while pumping. A water-cement ratio of 3.2 gallons per sack makes a neat cement weighing close to 18 pounds per gallon.

Even though it is possible to pump such a very low water-cement ratio, it may not be possible to place such a thick cement into a tight hole behind a string of casing. On that basis it often is more desirable and practical to use higher water-cement ratios than the minimum possible to pump.

For general oil well cementing practice the ratio of 4.5 gallons per sack has sufficient fluidity to assure proper placing in the majority of cases, has sufficient strength and plenty of safety factor for its purpose; has sufficient impermeability to shut off water, and is more likely to secure a closer bond with a jagged wall. In cases where it is felt conditions justify a lower water-cement ratio or where it is felt the job might require a higher one the ratio can be changed to suit conditions.

Control of Cement Mixture

When cement is mixed by hand the desired water-cement ratio is obtained by putting so many gallons of water in the mixing box for each sack of cement. This method is a good one, but by consuming considerable time and being limited to comparatively small batches, it is not used to advantage in oil well cementing, except in very shallow wells requiring a small amount of cement.

With the jet vacuum mixer, the ratios can be checked up in two simple ways. By gauging the amount of mixing water used out of the water supply tank and checking it with the number of sacks mixed. Another way is to catch a sample of the mixture and weigh it, the pounds per gallon indicating the water-cement ratio. Table No. 1 can be used with this method. A pair of specially calibrated scales showing water-cement ratios are made by the Chatillon Scale Company. They are sensitive to one gram, and have a special container for cement and special dial face showing direct water-cement ratio readings. The cement container is small, the size being practical due to the accuracy of the scales; it is easily cleaned after a reading by dipping in a bucket of water, and it is easily wiped to prepare it for the next reading.

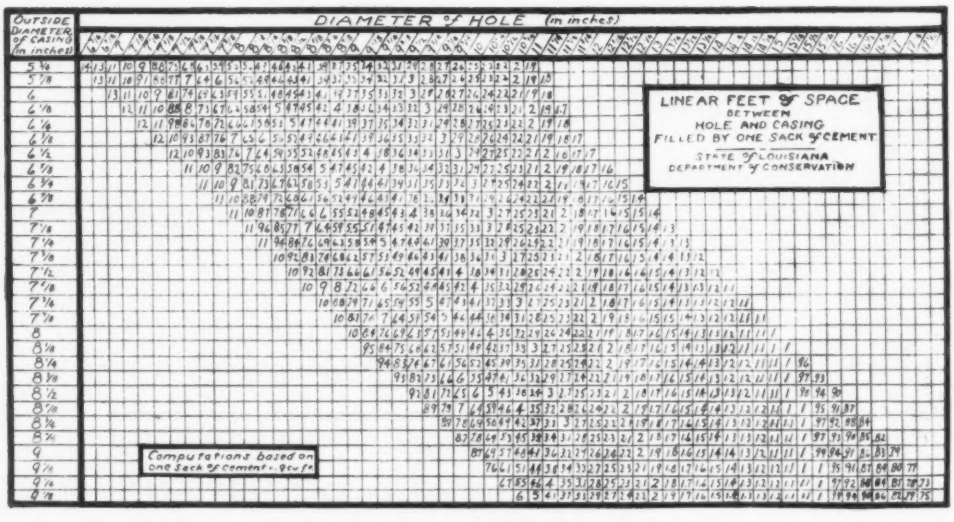
The expense of these extra checking up procedures is not necessary when the cementing is in the hands of experienced and competent men, but they are very useful in certain cases.

In connection with the jet vacuum mixer, an impression easily gotten is that regardless of the amount or speed of water going through the jet, the speed with which the dry cement feeds through the orifice in the bottom of the hopper is constant throughout the interval of mixing if the hopper is kept full of cement. This apparent condition, if real, would give very irregular mixtures. However, the speed with which the dry cement goes out of the hopper is not constant. It goes out only in such quantities and at such speed necessary to replace the amount of dry cement used by the mixer and carried out of the mixer by the speed of the water coming through the jet, and since the amount of cement carried out of the mixer varies, as explained later, then the amount of dry cement coming through the hopper orifice varies accordingly. Thus, if the mixer and its attachments are properly designed, the uniformity of water-cement ratios is not necessarily affected.

Another impression easily gotten, and related to the other one, is that changing the speed of the water pump connected to the mixer changes the water-cement ratio of the mixed cement. The fact is that slowing down or speeding up of the pump does not materially change the water ratio. For example, if the pump were slowed down, the speed of the water passing through the jet would be slowed down, consequently the vacuum which pulls in the dry cement would be decreased, and therefore, the rate of pulling in the cement would be decreased, thereby keeping the water-cement ratio approximately constant. It is an interesting fact that the speed with which the water travels through the jet in the jet vacuum mixer often is as high as 350 miles per hour.

The water-cement ratio on this particular type of mixer is easily adjusted. In practice a water nozzle of such length

(Turn to page 43, please)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Computations based on one Sack of cement - 94 cu ft

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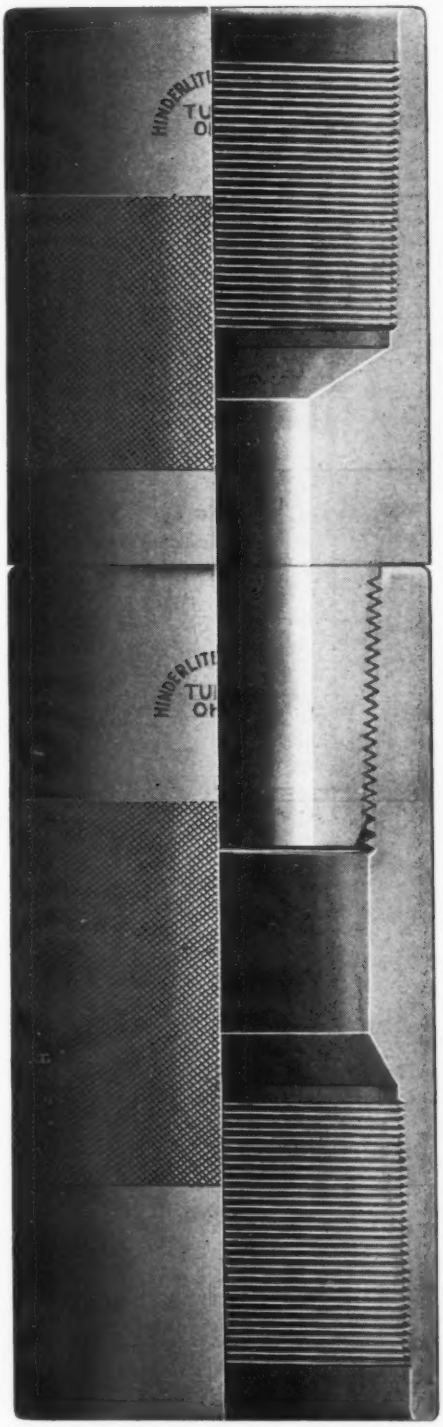

To manufacture the highest grade Rotary Tool Joints and equipment that skill and experience can achieve, is the responsibility of

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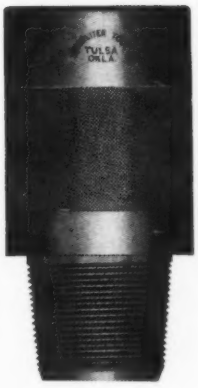

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Heat treated 'n Everything

HONEST TOOLS

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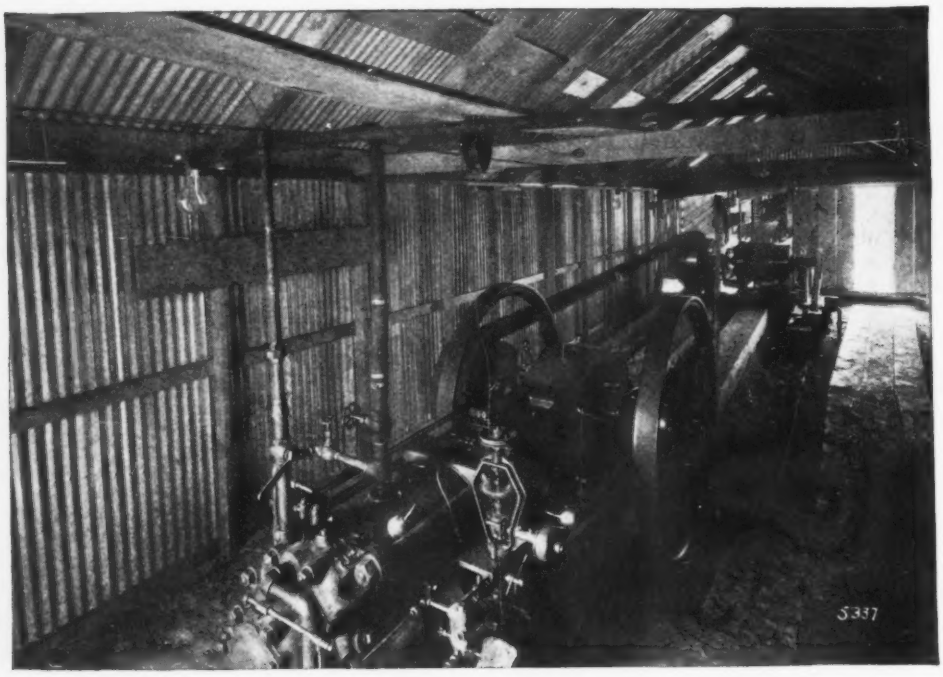
FRANKLIN VALVELESS OIL *and* GAS ENGINES



Facts Are the Yard Stick of Value

After all it isn't talk but actual facts that tell you how good a drilling engine is—here are some facts—

J. R. Robertson of Wichita, Kansas, owns and operates two new OF 80 HP Oil Drilling Engines and two BG Clutches.

The engine shown is on its second location at Creson No. 1—¾ of a mile north of Valley Center. On this engine's first well they set 255 ft. of 15″ pipe, 1,370 ft. of 12″ pipe, 2,433 ft. of 10″ pipe, 2,700 ft. of 8″ pipe and 3,200 ft. of 6″ pipe, completing the well at 3,466 ft. The well was started February 3rd and finished April 12th—actual drilling time not recorded. The fuel used was distillate 38-40 gravity. The average consumption was 35 gallons per 24 hours. At present Robertson's two engines are handling 9-inch balers 60 feet long in 10-inch holes.

Robertson says in a letter to us: "We have found this equipment to be very satisfactory for cable tool drilling, easy on belts and wire lines, also very economical on fuel and lubricating oils. Up to the present time we haven't spent a single penny for repairs on these outfits."

FRANKLIN VALVELESS ENGINE COMPANY, Franklin, Pa.

PRICES—40 HP Type OF Franklin, including water circulating pump and pulley. $1550 F. O. B. Franklin

50 HP Type OF Franklin, including water circulating pump and pulley. $2050 F. O. B. Franklin

80 HP Type OF Franklin, including water circulating pump, pulley and air starting equipment. $3200 F. O. B. Franklin

NOTE—Type OF is readily converted into Type OG for gas fuelization.

Some of the Franklin OF Good Points

Enclosed type

Low Fuel consumption

100% inter-changeability

Simplicity

Piston rod is fitted with metallic packing which never needs adjusting or replacing

Every spring exposed

Complete simplicity with practically no adjustment

In case of belt breakage engine automatically stops

Fuel pump driven by eccentric running in oil bath

Bearings are removable and reversible

Only standard threads used. No special wrenches required

Cylinder has 3 point, forced feed lubrication

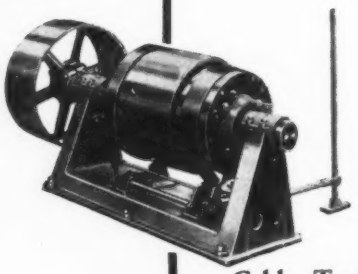
Balance of lubrication is splash feed

Pistons are air cooled

All nuts subject to vibration are castillated and fastened with cotter pins

Most economical to operate in fuel, lubricant, water and repairs

Easy to start.



Type BG CLUTCH for Cable Tool Drilling or Pumping

A vast improvement over the former type of clutches.

Driven from pulley on engine. Permits the use of a larger diameter pulley and makes possible a slower clutch speed. Operates by hand lever on derrick.

Construction and design prevent Reverse Clutch troubles.

PRICE — $1200.00 F. O. B. Franklin, Penna.

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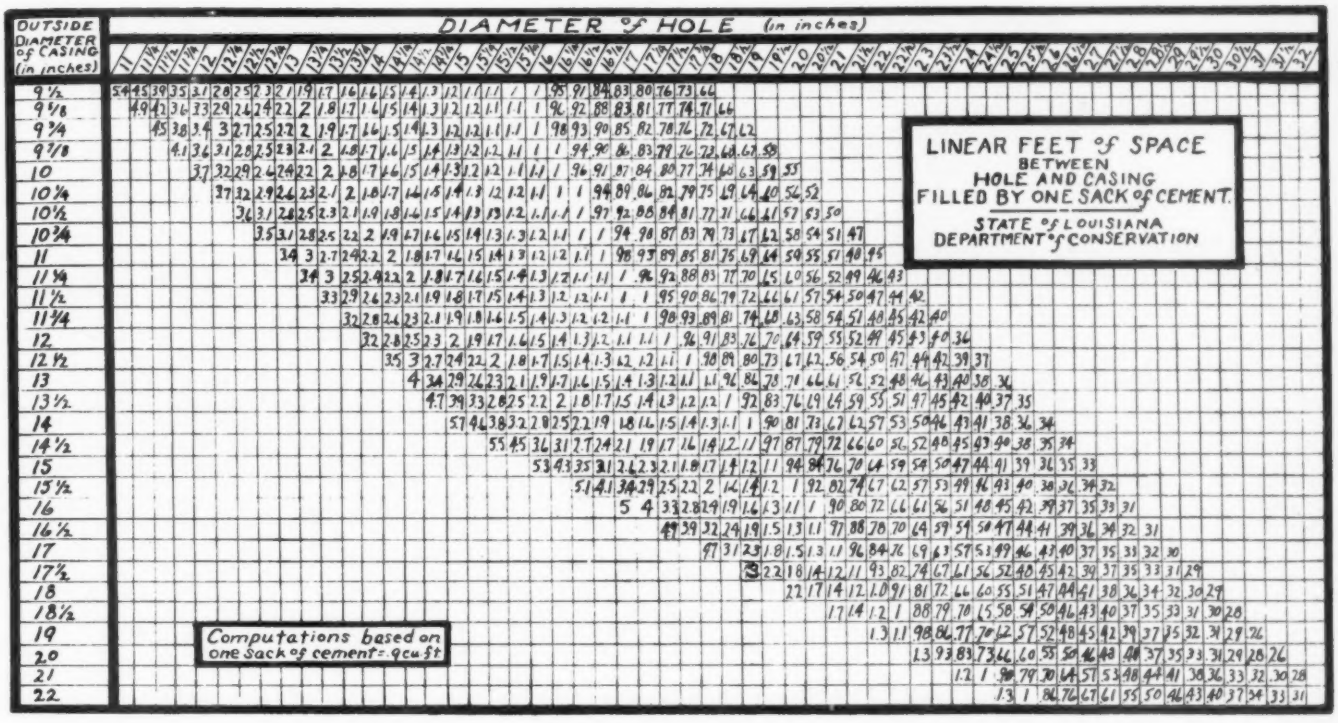
is used in the mixer to give a low water-cement ratio, and a by-pass, which also is part of the mixer, is used to increase and vary the water-cement ratio if the cement becomes too thick to be handled by the pumps or for other purposes.

From the above it is evident that when using a properly designed jet vacuum mixer and with no stoppages due to the lack of water, the water-cement ratios are easily controlled within a very practical range by the man in charge of the operations.

The Minerals Division of the Department of Conservation, State of Louisiana, has just worked out a useful and very thorough table showing the linear feet of space behind a string of casing filled by one sack of cement, and with their permission, the table is reproduced herewith.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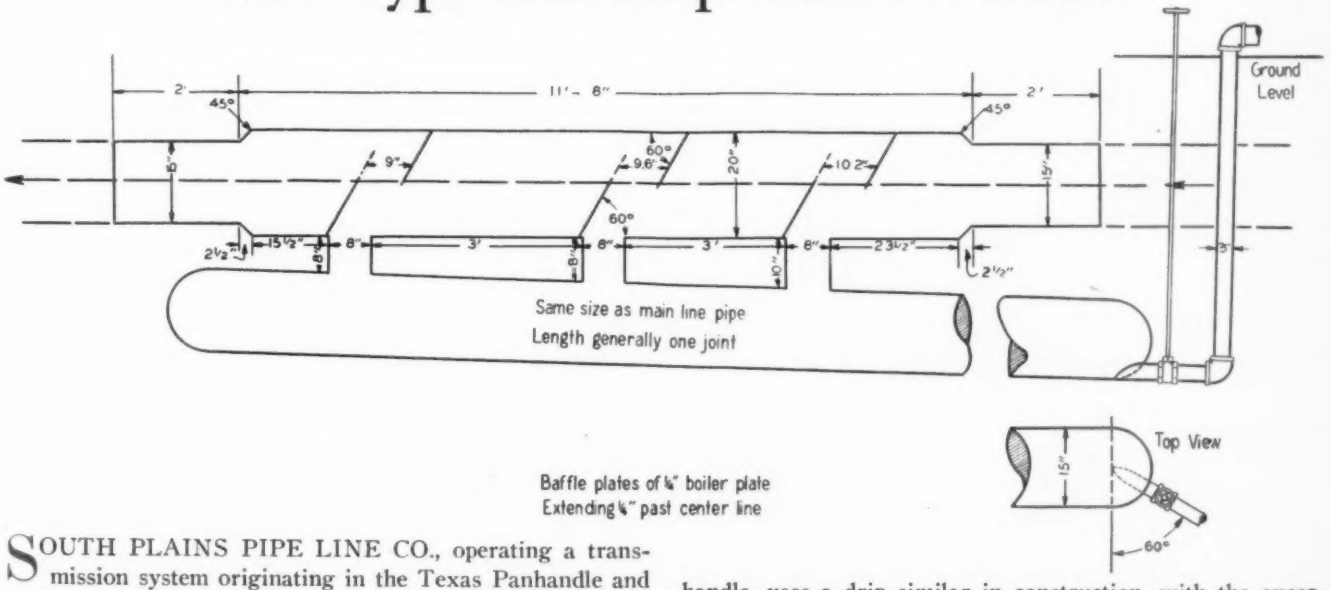
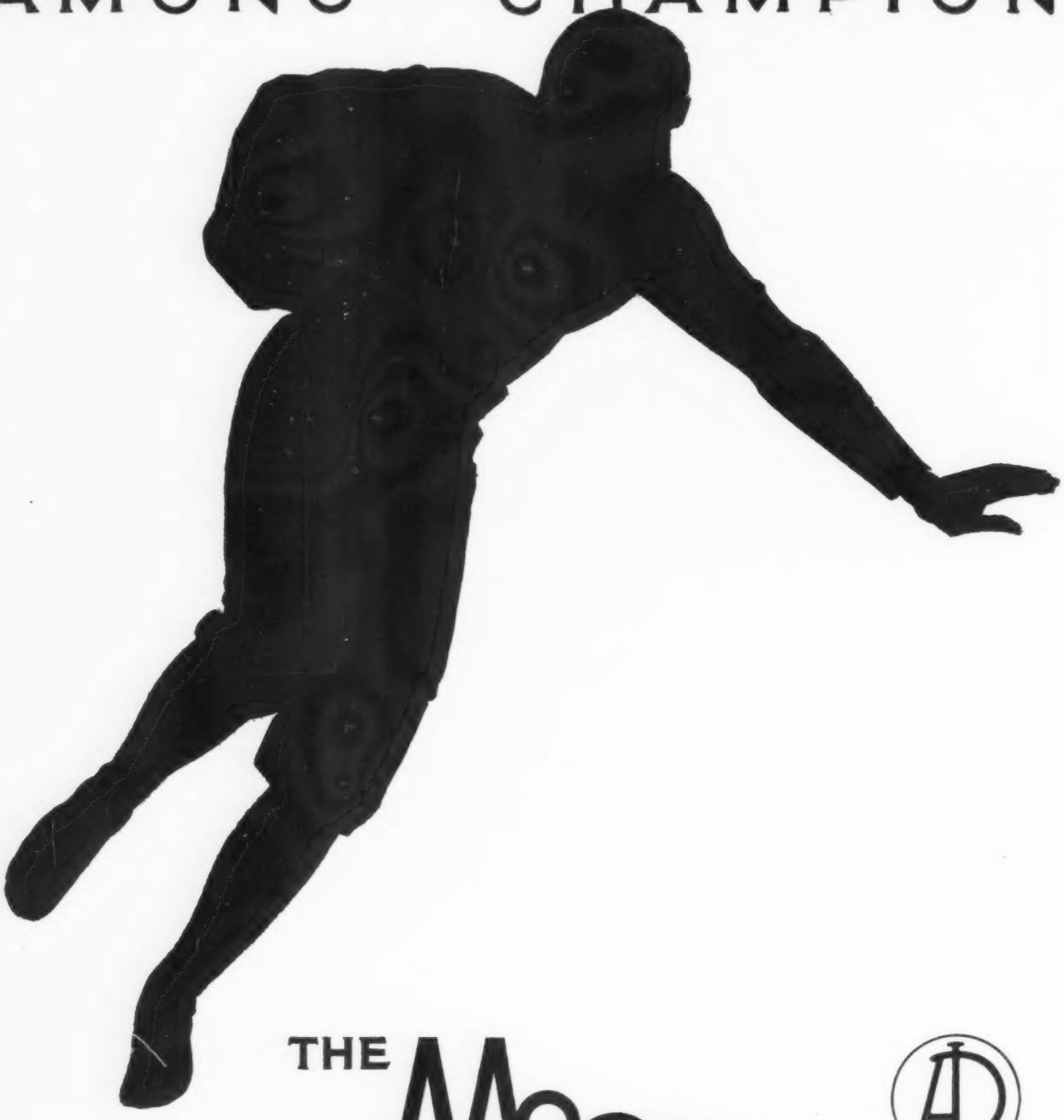
STATE of LOUISIANA DEPARTMENT of CONSERVATION
Computations based on one Sack of cement = 9 cu ft

New Type Gas Drip Used *in* Texas



SOUTH PLAINS PIPE LINE CO., operating a transmission system originating in the Texas Panhandle and terminating at Odessa, Texas, finds the type of drip shown in the above drawing to give excellent results. Near the point of origination of the line where the first drip was put, more condensate and sand is removed than from any other drip on the line. Very little foreign matter or condensate is blown out 20 miles away from the first drip. The Canadian River Gas Co., on its 22-inch system in Panhandle, uses a drip similar in construction, with the exception the main part of the drip is the same diameter pipe as the main line pipe and not larger, as in the case of the Southern Pipe Line Co.'s shop-made drip. The Canadian company's drip also has a standpipe made of the same diameter pipe as line pipe, welded in below the first two baffles in the drip. This is to permit the rapid escape of ice forming in the line.

AMONG CHAMPIONS



THE Moore Champion DERRICK

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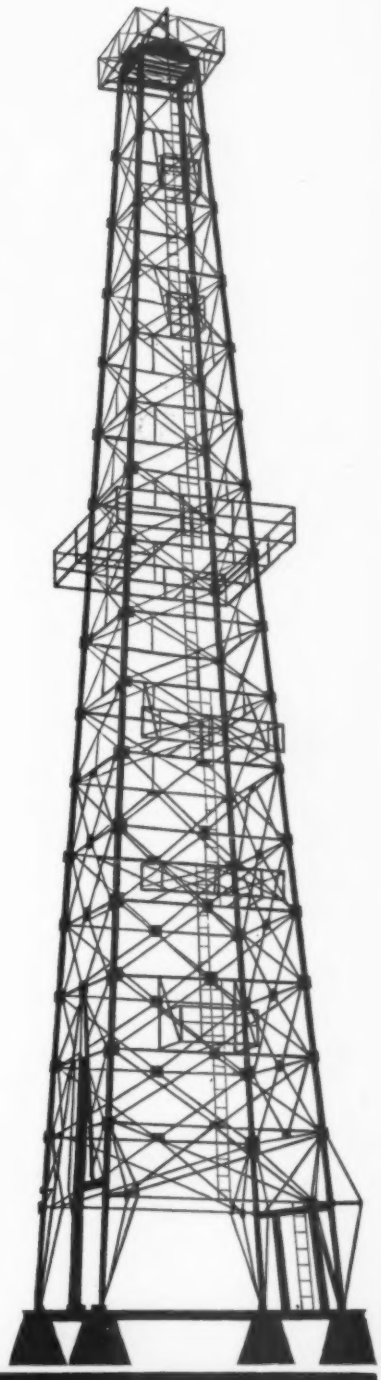
STRENGTH

Strength is the vital essential of all champions. In a man—strength of muscle, nerve and character. In a derrick—strength in design, in materials and in assembly. Moore Champion Derrick strength results from the complete unity of the several parts, each with strength in proportion to the demands upon it.

The legs, which bear the brunt of the load, are of seamless pipe of 40-50 carbon steel. This is the strongest shape for carrying compressive loads. The clamps, girts and braces, base plates, tops and other parts of the derrick are all of sturdy steel construction. The Moore Champion Derrick surely has strength in abundance.



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Stocks in All Principal Fields

Reducing Loading Losses *at* Refineries

By J. J. THOMAS,

General Manager, Burford Refining Co., Pecos, Texas

TO load gasoline without losses is to economize. The actual accomplishment of this goal has been approached but not reached. Countless devices have been tried and discarded; other experiments are being made daily. The description of another device will add to your fund of knowledge, and possibly assist someone in cutting down their loading losses.

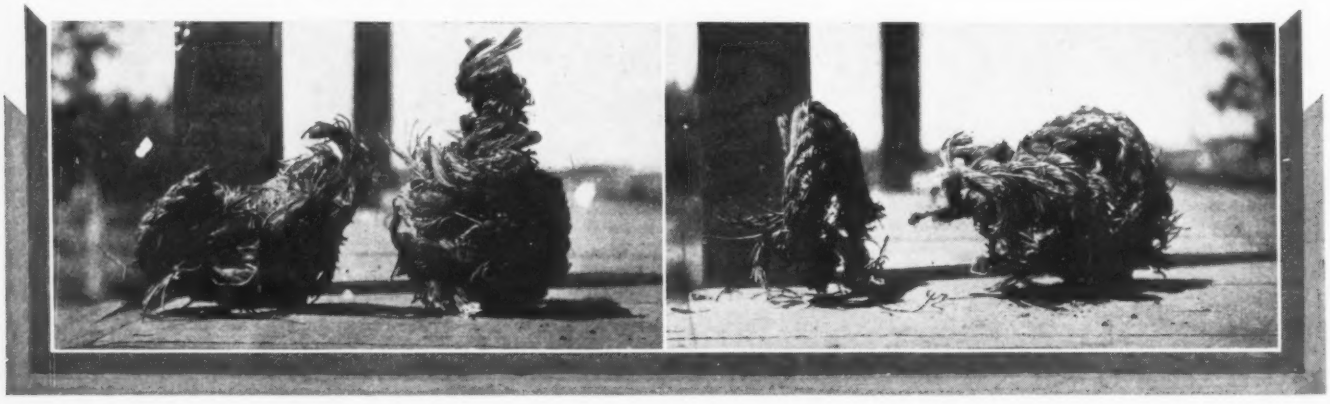
There are several features to consider in designing loading equipment; one of the most important requirements is flexibility. It is a difficult task to "spot" a tank car on the exact location, therefore loading apparatus must permit at least 18 inches tolerance. The loading apparatus should not be cumbersome or weighty. It is customary for one man to do the loading of one commodity, therefore it is essential that the equipment be of such weight and character that an individual can handle it with ease and speed. The necessity for the loader to be able to observe the level of the liquid as it rises in the tank car is paramount. Numerous contrivances have been conceived to produce warning signals, but they do not always work. Actual observation will prevent a tank car from running over.

We allow for flexibility by using the sleeve type filler pipe. A nipple about three feet long is attached to a McDonald swing joint. A galvanized filler pipe or spout, made of twelve gauge material, slips over this nipple about eighteen inches. The other end of the filler spout is curved, at about a sixty degree arc, so that it looks straight down to the bottom of the tank car. A one-inch band is soldered around each end to make the spout sturdy. The spout weighs about six pounds. The end of the filler spout fits into a funnel that rests on the dome cover opening. The funnel has a barrel that extends to the bottom of the tank car. This piece of equipment weighs about nine pounds. There are openings in opposite sides at the end of the barrel of the funnel. There are two slots in the face of the funnel that slip up and down. These openings enable the loader to see in the car. As the level nears the shell, these slots remain open.

The funnel is placed in the tank car, the filler spout is slipped over the end of the nipple of the loading riser, the other end is placed in the funnel, as shown in the picture, and you are ready to start loading. This device permits submerged loading, and allows for a minimum agitation of the gasoline during the operation. Loading with this device has made it possible for us to load gasoline that has the same gravity as the material in the storage tank. Before this method was installed, there was as much as one-half degree in gravity lost during loading. If loading was continued up until the warmer hours of the morning, one point in gravity has been lost. The saving effected by using this equipment is obvious, if you should pass the tank car when it is being loaded. The escape of vapors around the top of the funnel is barely discernible.

Previous to the employment of this device a cloud of rich gasoline vapors rolled out of the dome of the tank car—lost to the use of man and machinery. By actual measurement we have reduced our loading losses fifty gallons or more to the tank car. The material and labor used in making this equipment was more than paid for during the first week.

Specially designed loading equipment used by the Burford Oil Co. at its Pecos (Texas) refinery.



The illustration above might resemble a couple of game chickens taking a tough ten rounds, but closer observation will reveal that it is only two pieces of oil-country wire line after a tough battle far beneath the ground.

The two pieces of wire were recovered after an expensive fishing job in the Oklahoma City oil field, and illustrate what fishing can do to good oil-country equipment.

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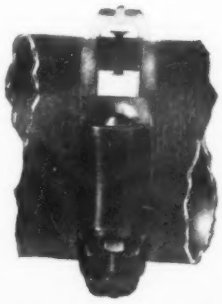

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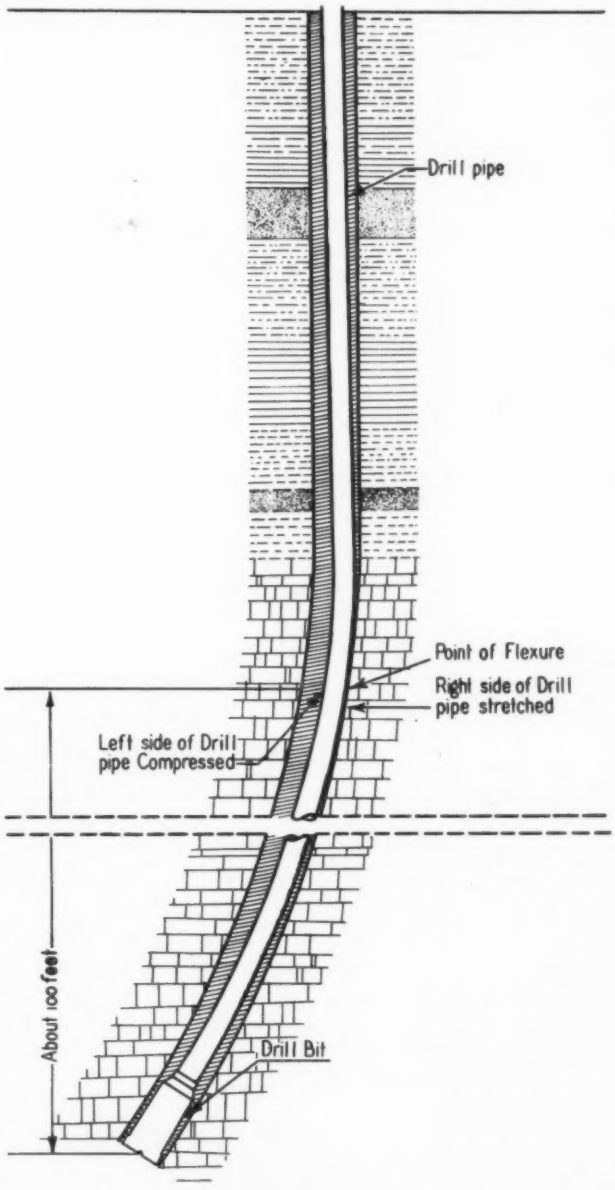
Drill Pipe Flexure *and* Crooked Holes

By W. P. HASEMAN, Ph. D.
Consulting Petroleum Engineer, Oklahoma City, Okla.

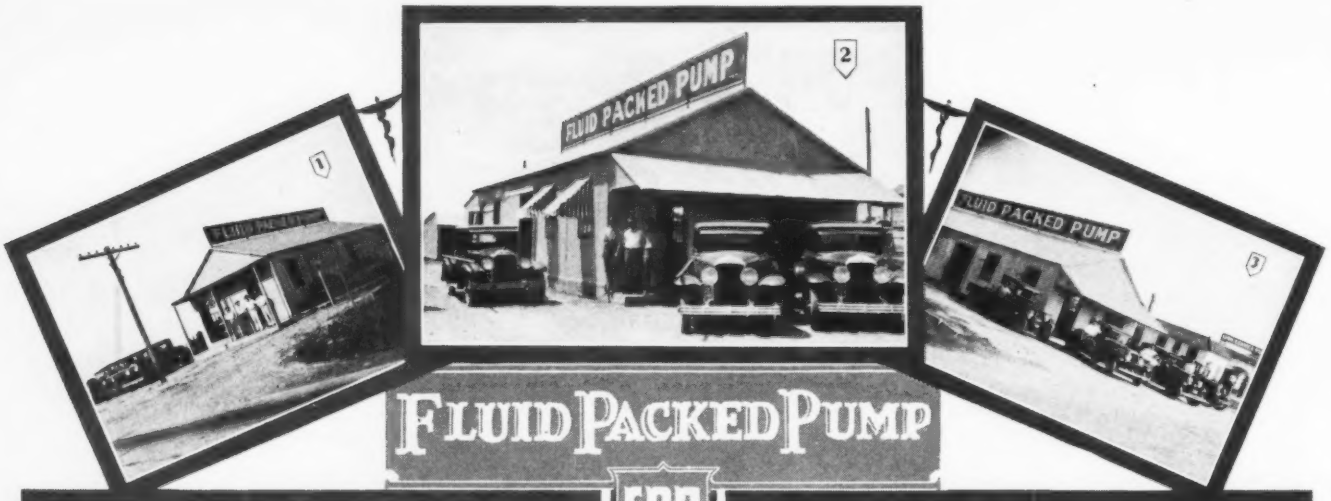
CHANGES in physical characteristics of formations, caving, bit pressure, and other factors may independently or collectively cause the bit to drift or deviate from a vertical course. Irregular and enlarged sections of hole may result through caving. Long strings of drill pipe are necessarily flexible and of smaller diameter than the drilled hole, and allow the bit to drift or deviate from its course, hence the problem of drilling vertical holes is difficult of solution in actual practice.

As the hole becomes deeper, the ever-increasing length of the drill pipe accentuates the tendency of the drill bit to drill a hole that deviates from the vertical. The drill pipe will become flexed in one or more sections of its total length. Each flexed section causes the drill bit to deviate from its course and to continue to deviate more and more as the drilling depth increases.

To describe and illustrate the action of a flexed section of rotating drill pipe in deviating the drill bit from a vertical course, let it be assumed that a given flexed section of the drill pipe, say at a hundred feet above the drill bit and a thousand feet below the earth's surface, has its maximum lateral displacement in a direction to the right (see illustration). This marks what may be termed the zero position of the drill pipe. In this position the right side of the flexed pipe is stretched while the left side is compressed. Upon applying a torque to the upper end of the drill pipe, an angular twist will be produced in the drill pipe which will cause the drill bit to rotate. As the stretched side of the flexed section of the pipe is turned and moved over toward the left side of the hole, additional flexures will be set up at one or more positions along the pipe. The torque will continue to increase as the flexed section moves around in the hole and approaches a position, say, in the neighborhood of 180 degrees and diametrically opposite the zero position. At or near the 180-degree position the greatest resistance to the torque will be encountered and the added stresses, both torsion and flexure, will be a maximum. The flexed section will approach this 180-degree position with a decreasing angular velocity and likewise the drill bit, if rotating at all, will be rotating with only a small velocity. As soon as the flexed section moves past the position of greatest opposition to the torque, then the stresses set up in the drill pipe by the added torque will suddenly return the flexed section of the drill pipe to the zero position. Likewise, the drill bit will suddenly increase in angular velocity. The flexed section of the drill pipe in its return to the zero position moves across the hole with a linear acceleration such as can be given it by only a powerful blow. This acceleration of the flexed section of the drill pipe to the right sets up a stress in the drill pipe which is transmitted down the drill pipe to the drill bit. The drill bit will, therefore, in accordance with a fundamental scientific principle, impact the left side of the hole. Each and every revolution of the top end of the drill pipe will cause the cutting edges and surfaces of the drill bit to impact the left side of the hole. This continuous action will cause the drill bit to drill a hole which deviates more and more to the left from the vertical course. The effectiveness of this action in causing the drill bit to deviate depends upon such factors as the nature and character of the flexed section of the drill pipe and the nature and length of the drill pipe from the flexed section to the end of the drill bit, etc. This action of a rotating flexed drill pipe furnishes a basis upon which there has been developed by the writer a method of, and apparatus for, drilling and maintaining a straight hole.



(EDITOR'S NOTE: The use of guides and lace joints immediately above the bit has been adopted with some success in overcoming the troubles due to flexure as described by Dr. Haseman in this article.)



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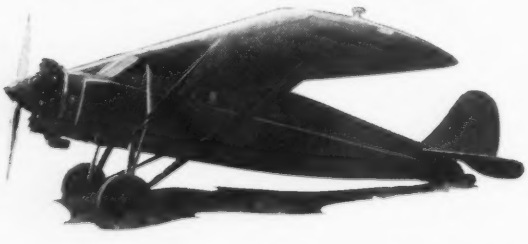

ROBERT N. ATMORE COMPANY
FLUID PACKED PUMPS

Largest Sea Terminal

Equipped *for* Loading Tankers *in* Six Hours

By J. H. DAMERON

DOWN on the Gulf Coast near Corpus Christi, Texas, is located the world's largest pipe line terminal for handling ocean shipments of crude oil. In physical size the terminal itself, at a glance, does not reflect its rank. But the records at the Humble Pipe Line Company's Harbor Island docks reveal there is more to the terminal than meets the eye.

In these days of endless record-breaking achievements either in endurance flights or otherwise, the crew at Harbor Island established a new mark in loading cargo. It's a record of which C. E. Dixon and his small corps of assistants and crews are proud.

To establish a speed record in cargoing an oil tanker required some fast work in spasmodic periods. A 120,000 barrel tanker was docked, cargoed and on its way to the rough waters of the Gulf in six hours and thirty minutes. This record is all the more remarkable because the total time consumed is from sea buoy to sea buoy. When the tanker passed a sea buoy on its way to the dock (which is three miles out), it was clocked. Six and a half hours later it passed the same buoy on its way to sea with a full cargo.

Loading a 120,000-barrel capacity ship in that length of time of course required facilities at the terminal for pumping an enormous delivery at a rapid rate; but to establish the record required rapid work on the part of pilots, inspectors and crews. As is the case in docking every tanker, the dock crews are ready to start pumping oil into the tanker's compartments a few minutes after she is tied up. Inspectors carry on their work as the ship is being docked and loaded, determining whether the tanker is seaworthy, reasonably safeguarded against accidents and the multitude of other duties they perform.

A tanker at the Humble terminal just about ready for sea.

The tankers are divided into compartments, the number depending on the design and capacity of the ship. Usually they have twenty-two compartments with the engine room located aft.

To drive the cargo into the compartments the four low-head single-stage double-suction centrifugal pumps, directly connected to motors, have a rated delivery of 30,000 barrels per hour. While making the record loading, the pumps were delivering crude at the rate of 26,086 barrels per hour. Usually they are operated to deliver on an average of 24,000 barrels hourly.

Pumps and motors are separated by a gas proof fire wall and the outside dimension of the station is 73 by 23 feet. The operating pressures of the pumps range from 40 to 50 pounds.

One of the advantages of the centrifugal pumps is that the header gate can be closed off against the pump without endangering the lines or pumps. Loading at such high speed, the ship's crew will not hesitate to close the gates against the stream to avoid running tanks over.

Maximum delivery is made at Number 2 dock which is approximately 600 feet distant from the pumps. At Number 1 dock, which is approximately 1,200 feet distant from the pump station, delivery is approximately 15,000 barrels hourly. The pumps and motors are housed in a sheet iron building with the equipment located in a walled-in excavation to take advantage of gravity from the tank farm.

Little time is lost in flanging up connections when the tanker docks. As the first line is being cast to tie the ship to the dock the dock crew clamps the static ground to the hull as a precaution against any static explosion. On deck, crews are preparing for connections from the dock. Dock crews swing the eight-inch rubber and fibre hose connection to the deck with derricks which are operated by hand winches. These are flanged to the connections on deck as shown in the illustration and seven minutes later the pumps are delivering oil into the compartments. Because of the fire hazards, extensive precautions are used to minimize the danger of explosions. All of the electrical fixtures are vapor-proof. No smoking is permitted on the docks and small fire extinguishers are always handy. Fire hydrants are spaced in accessible

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1. ***Protect casing from wear.***
The only contact between pipe and casing is rubber.

2. ***Protect collars and tool joints.***
The Protector has a larger diameter and makes contact instead of tool joint or collar.

3. ***Save power. Less fuel.***
Less steam or electricity required because of reduction in friction.

4. ***Drill straighter hole.***
Protectors act as guides.

5. ***Better control of drilling.***
Because of less friction Driller is better able to tell what drill is doing.

6. ***Faster drilling.***
Less loss of time and better control of drilling.

7. ***Fewer fishing jobs and twist-offs.***
Less strain on drill pipe and more accurate control.

8. ***Help prevent collapse of stovepipe.***
Thinness of stovepipe permits easy wearing through unless Bettis-protected.

9. ***Help prevent seat of stovepipe from breaking.***
Excessive pounding of collars in large hole.

10. ***Protect drill pipe from fatigue.***
Crystallization and fatigue of pipe retarded by elimination of metal-to-metal contact.

11. ***Save brake band lining.***
When running in, pipe has tendency to float.

12. ***Less water to pump.***
Less steam required at rig on account of less power needed.

13. ***Longer life to wire lines.***
Less friction; therefore less load when pulling out.

14. ***Less strain on derrick and engine.***
Minimum strain results in longer life to equipment.

15. ***Less vibration.***
Because of rubber contact, hard shock and excessive vibration are overcome.

16. ***Salvage value of casing increased.***
Because of no internal wear, casing has highest salvage value.

17. ***Serve as float for dropped drill pipe.***
When pipe is dropped in hole by accident the Protectors act as floats and frequently prevent corkscrewing. (Six authentic cases, to our knowledge, where pipe has dropped as much as 5,000 feet and was unharmed.)

18. ***Increase life of drilling string.***
Because of less vibration, less strain, practically no abrasion, etc.

19. ***Less tonnage of equipment to transport.***
Large saving in transportation of fuel, replacement pipe, casing, tool joints and collars. (Especially important in wildcatting.)

20. ***More flush production.***
Because of faster completion, more flush production is obtained. (Especially important in offset drilling.)

21. ***Will not obstruct fishing tools or clog circulation.***
No metal used. Nothing but rubber. Fishing tools will push them ahead and not delay the job.

22. ***No time lost where installing.***
Only few seconds required per Protector.

23. ***Less magnetism.***
Rubber serves as insulator, decreasing magnetism of pipe and casing.

24. ***Minimum investment in warehouse stocks.***
Large saving in pipe, casing, tool joints and collars.

25. ***Total cost of well is less.***
Saving of time and equipment results in less cost for entire drilling operation.

26. ***Insure better water shut-off. Fewer water breaks.***
Casing is not severely pounded or subjected to abrasion.

27. ***Later pumping costs reduced.***
Wells are straighter, reducing later rod and tubing costs.

Reasons *for* PROTECTORS

28. *Ultimate life of wells increased.*
Casing is not worn thin; therefore water intrusion delayed.

29. *Can't fall in hole.*
No danger of Protectors causing bad fishing job being made if seamless rubber (without metal) is used, it being lighter than rotary mud.

30. *Retain original grip on drill pipe.*
Because of inherent resiliency of specially compounded rubber, the Protectors never lose their tight grip on pipe until eventually worn out.

31. *No metal to injure workmen.*
Made of seamless rubber, protected by basic patents—no pins, hinges, or metal projections that might injure workmen.

32. *Less corrosion.*
There being no metal in the Protectors, no rust or corrosion can take place.

33. *Most economical.*
Longer life, quicker installation and lower costs in all drilling operation make Bettis Protectors most economical.

34. *The original and genuine Protectors.*
First anti-friction rubbers and the only Protectors covered by basic patents that cover the entire field of anti-friction rubbers.

FULLY PATENTED

35. *Solely applicable to Hopkins Tool Joints.*
Basic Bettis and Hopkins Patents and fundamental design make available an anti-friction Tool Joint that is unquestionably the best and most practical ever introduced. Hopkins Tool Joints manufactured, under license, by leading Oil Tool Manufacturers.

36. *Resists oil.*
While not guaranteed against hot or high gravity oil, Bettis Protectors show unusual service in wells when such oil is circulated.

37. *Save top casing.*
Applied to Kelly joint, expensive replacement of top joints of casing is saved.

38. *International distribution.*
Stocks are carried in all principal oil fields, and Bettis Protectors are offered at a price far below their actual worth to the industry.

39. *Less cost of rethreading.*
Rethreading of pipe and replacement of joints and collars is considerably less.

40. *Less labor costs.*
Direct and indirect labor costs are greatly reduced.

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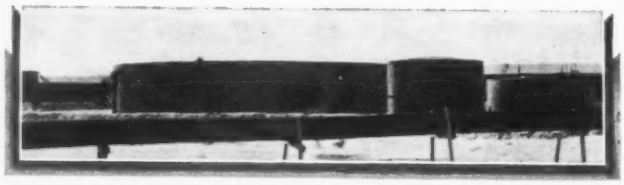
places along the dock and around the plant. A central foam generating plant is located a short distance off shore near the pumping station.

An inspection is made of the foam plant daily. Its centrifugal pumps are driven by a 200 horse-power motor. In case of a shut off of power during an emergency, a gasoline engine auxiliary power unit is available and by special clutch arrangement it can drive on the same shaft with which the motor drives the pumps. Lines from the foam plant have been extended to each of the tanks at the terminal to smother a fire there in case of an explosion.

Power for the company's various electrical units is generated at the Humble's own power plant at Ingleside. Three 600 horse-power Diesel engines directly connected to three 500 kw generators supply power to the terminal at Harbor Island and Ingleside and to the company's refinery at Ingleside.



Ballast disposal tanks at the terminal.

Originally the transporting company's terminal was at Ingleside harbor. Later when a more elaborate terminal facility was necessary, the Harbor Island terminal was built. It is six miles off the mainland and accessible by either boat or rail. The rail artery is referred to in that territory as the modern Toonerville Trolley. While its rolling stock is laughing stock in a good-natured manner, the short line affords excellent service and its capital stock pays an enviable dividend every quarter.

The rail line is built on a trestle. Its prime mover is an ordinary heavy-duty truck mounted on hand-car trucks instead of regular truck wheels. A bus type body has been built on the truck to accommodate passengers. Usually the "engine" pulls three flat cars which are used to haul automobiles and freight. The rail line terminates near the ship channel and a ferry is used to transport passengers and freight across the channel to the island.

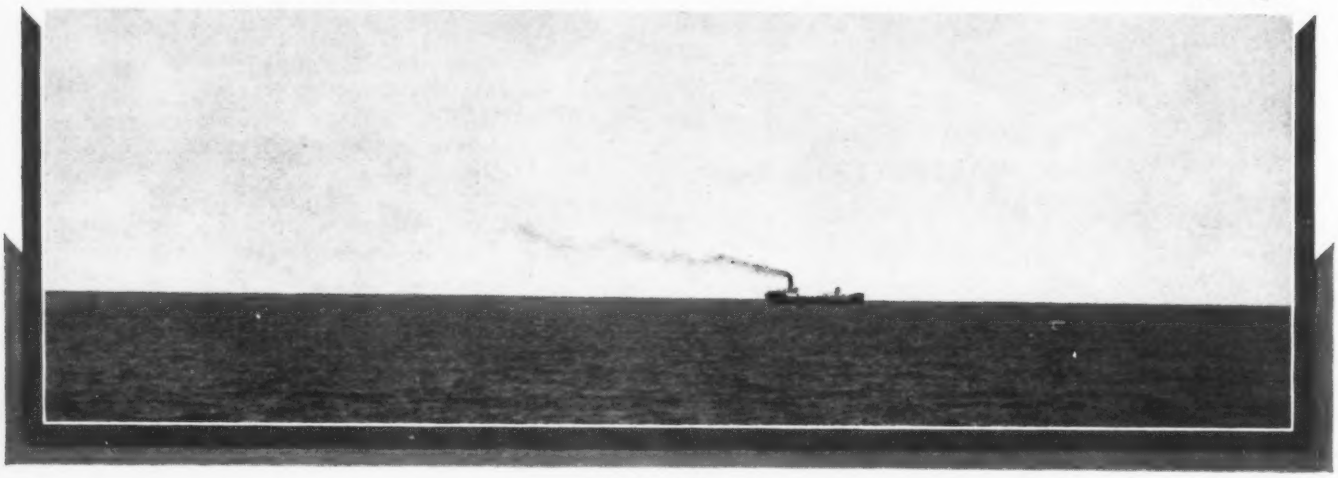
When the Humble extended its oil lines from Ingleside to Harbor Island, they were laid near the foundations of the trestle. Communication lines were built along the sides of the trestle.

Ingleside dock is used now to load cargoes of gasoline, gas oil, fuel oil and Mirando crude. Facilities there can handle only 5,000 barrels per hour. Harbor Island terminal handles chiefly West Texas sulphur crude, and fuel oil. The same layout of gas masks that will be found on West Texas tank farms are used at Harbor Island by employes when exposed or likely to be exposed to the sulphur fumes.

Storage at Harbor Island consists of six 80,000 barrels tanks for crude oil and two of the same capacity for fuel oil. In construction these tanks differ in base measurement from regular tanks, having a 140-foot base. They were purchased to meet soft soil conditions on another island not far removed from Harbor Island. The fuel oil tanks are equipped with steel roofs and the crude oil tanks have wood roofs. All tanks are insulated and grounded with static arresters.

While a tanker is being cargoed, gravity and centrifuge tests are frequently made and records kept.

Upper—"Topside" view of a modern tanker. Left—Hose connections on the dock. Right—The short end of the dock, showing the position of lines which deliver crude and refined oils to the tankers.



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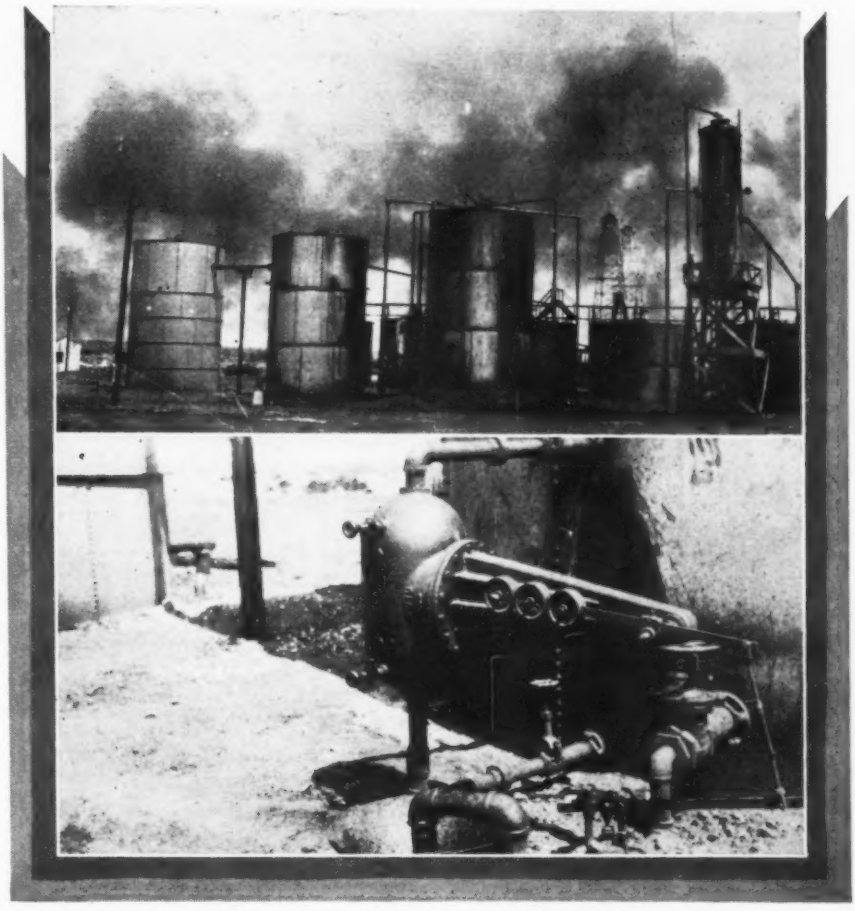
Outline *of* Principles Governing Oil Treatment *by* Chemicals

Handling "Cut" Oil *in the* Field

By W. A. OBERLIN
Engineer, Wm. S. Barnickel & Co.

WITH the present low prices being paid for crude oil, oil producers are faced with the problem of maintaining their operating and lifting costs at the lowest possible figure. The various factors comprising the lifting cost are being carefully analyzed with the purpose of making reductions wherever possible. These analyses have shown room for considerable improvement in those details previously regarded as of minor importance and not worth the attention necessary to bring about the possible savings. One integral part of the production cost which by proper control and by proper selection of the best methods can be materially reduced is what is commonly known as "cut oil treatment," or the reduction of the water and B. S. content of the oil to the requirements imposed by the purchasers of the oil.

It is the purpose of this acticle to aid the producers in the reduction of their treating costs by setting forth the basic principles governing oil treatment by the chemical method, as a proper understanding of these principles will enable the correct type of treating plant to be erected, and will eliminate the greater percentage of trouble usually encountered when trying to treat cut oil by the wrong method. No attempt will be made to discuss the theories involved in the formation of cut oil or in the breaking of the emulsion.



Upper picture—Treating plant on Superior Oil Co.'s lease, Howard County, Texas. Lower—Automatic float control for regulating water level on excelsior tanks.

The first step to be taken when preparing to arrange for treatment is to determine the nature of the foreign substance in the oil. A centrifuge test on the oil will show whether the foreign substance is free water, B. S., paraffin, silt, or other sediment. Usually all foreign matter except free water is classified as B. S., but care should be taken to determine whether this B. S. is actually emulsified water or whether it is paraffin, silt, sand, etc. In those cases where the so-called B. S. does consist of paraffin or silt, treatment by ordinary chemicals is of little avail, as all these oil treating chemicals are designed primarily to break the emulsion of water in oil, and do not have great power of dissolving the paraffin or separating the solid material. Such cases as these, however, are very rare, and are easily recognized; any difficulty caused by them usually can be overcome by the application of heat. The main thing to be determined is whether the water in the oil exists in the free state or whether it is emulsified with the oil. Misleading conclusions are sometimes drawn from the fact that the centrifuge test on the oil shows only free water and no B. S., whereas the water is actually emulsified with the oil and was broken down by the centrifugal force employed in making the shakeout. Wherever there is any question or doubt, the original sample should be examined for cloudiness, as cloudiness in oil—when viewed in a thin layer on a piece of glass—indicates the presence of emulsion. Consideration should also be given to the method in which the sample was obtained. The most reliable sample is secured directly from the tanks into which the oil is producing, as samples taken from valves or bleeders along the lead line may be further emulsified due to the restriction of the valve through which the sample was drawn. Many wells which produce clean oil and free water will show several per cent of emulsion in samples due to the cutting of the oil through the sampling valve.

Selection of Chemical

After determining that there is emulsion present, the

next step is the selection of the proper chemical formula to break that particular emulsion. No one formula can be used to break all types of emulsions, as oils and waters produced from different horizons and different fields have widely varying characteristics and form entirely different types of emulsion. The selection of the proper chemical formula is usually done by the representative of the chemical manufacturer. These men are especially equipped with all the apparatus necessary to carry out this testing work, and can furnish information as to the amount of chemical required and the temperature necessary.

Perhaps the factor that is of the utmost importance in keeping treating costs at a minimum is the introduction of the chemical at a point where a maximum of agitation is obtained after the chemical is introduced into the oil. Disregarding temperature, a certain amount of emulsion can be broken with a small amount of chemical and a large amount of agitation, or with a large amount of chemical and a small amount of agitation. As the installation of baffled pipes, looped lead lines, chokes, etc., are an added expense and in most cases impose an excessive back-pressure on the producing well, it is the most economical method to take advantage of all the natural agitation furnished by the well hook-up and introduce the chemical at a point as close to the well head as is possible. There are some instances where it is possible to have too much agitation; that is, the emulsion will be broken down and the free water and oil will again emulsify before the water has had an opportunity to separate from the oil. Such instances are the exception, however, and can easily be remedied by introducing the chemical at the most advantageous point.

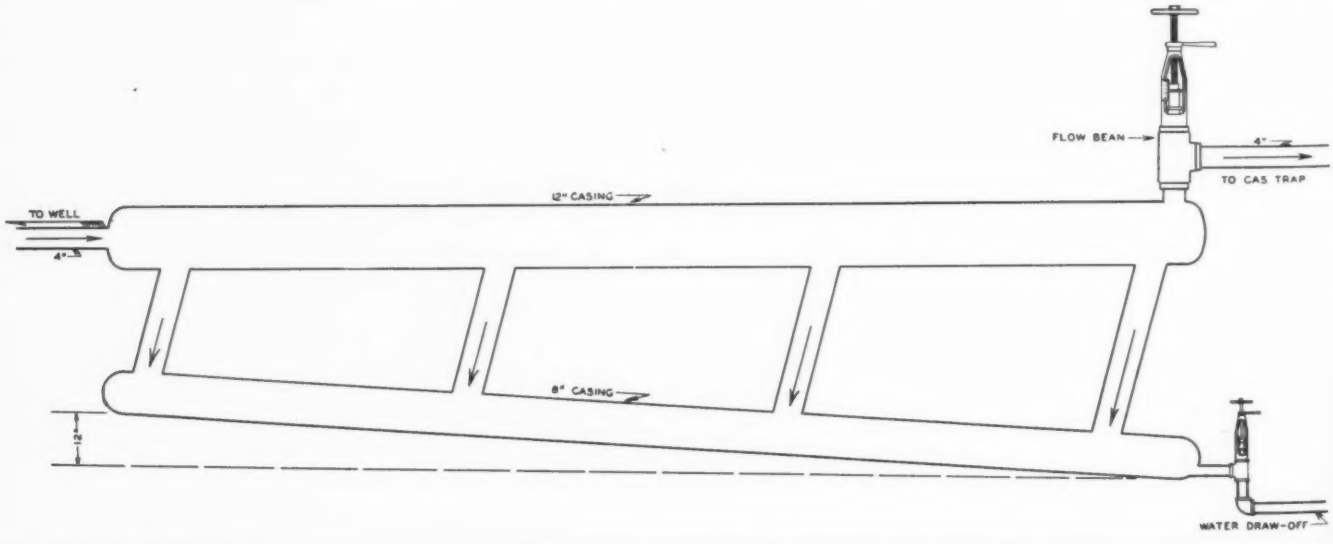
For the best results, the chemical should be introduced into the top of the Christmas tree if such hook-up is available, or as close to the casing head as is possible. Introduction of the chemical into the oil after the fluid has passed through the gas trap will result in an excessive use of the treating reagent, as the amount of agitation available after the gas has been removed is very limited. The treating reagent, almost universally placed on the market in fluid form, can be introduced either by means of the gravity type lubricator or by a force feed pump. More accurate control is possible with a force feed pump as such pumps are more positive in their action and are more easily regulated to introduce the desired amount. On wells where the amount of fluid to be treated is small, and the corresponding amount of chemical small, it is desirable to dilute the treating reagent with either oil or water, as the larger the volume of the treating reagent, the more uniform the mix with the cut oil.

On those types of cut oil where an increase over the well temperature is required for the complete breakdown of the emulsion, the heating should occur as soon as possible after the introduction of the chemical, and also at a point where the oil will undergo considerable agitation after being heated or while being heated. For this reason, the boiler type or heater or other type of heat exchanges give more efficient results than the heating in the flow tank or settling tank by means of steam coils. Passage of the cut oil through the boiler heater or heat exchanger is usually accompanied by turbulent flow due to the small diameter of the pipes, whereas in a large tank movement is fairly slow due only to the gradual filling and overflowing and to convection currents. As it is desirable to keep the oil as quiet and as slow moving as possible in the flow tank, in order to allow settling of the water to take place, it can be seen that the flow tank cannot be used efficiently for both purposes.

Temperature and Amount Chemical

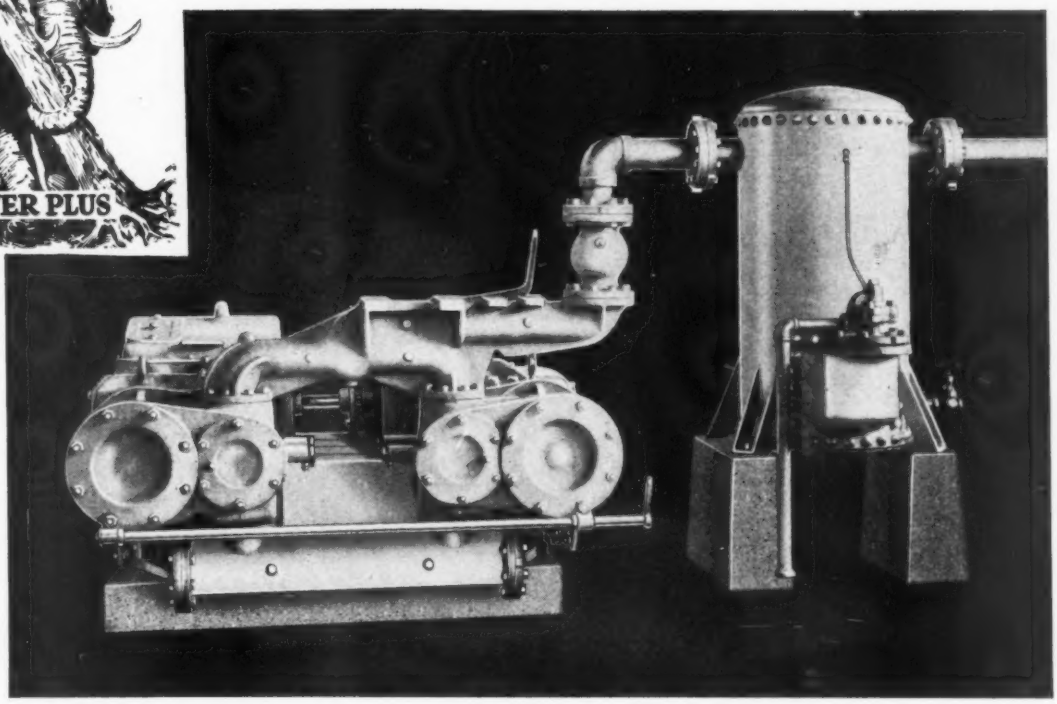
The temperature to which the oil is heated is one of the most important considerations in the treatment of cut oil. As in the case of the amount of agitation required, there exists a direct relationship between the amount of chemical and the temperature required. The higher the temperature employed, the lower the amount of chemical required, and vice versa. As the increase in temperature is accompanied by the loss of the lighter fractions and corresponding drop in gravity and volume, it is the more economical process to increase the amount of chemical used and decrease the temperature required, thereby saving gravity. In many instances, an increase in the amount of chemical used corresponding to as much as 1c per barrel, has been accompanied by an increase of one or more degrees of gravity, making the price of the oil five to ten cents more per barrel, depending on the price gradient for varying oils. A recent innovation in oil treating methods, introduced by the Tret-O-lite company, is the use of excelsior tanks, commonly known as hay tanks. By means of these, it has been possible to treat oil successfully at well temperature, where previously it had been necessary to apply a considerable temperature increase. These excelsior tanks will be discussed in connection with flow tanks and settling tanks.

The detailed construction of heat exchangers and boiler



High pressure trap installation.

Drilling the World's Oil Wells



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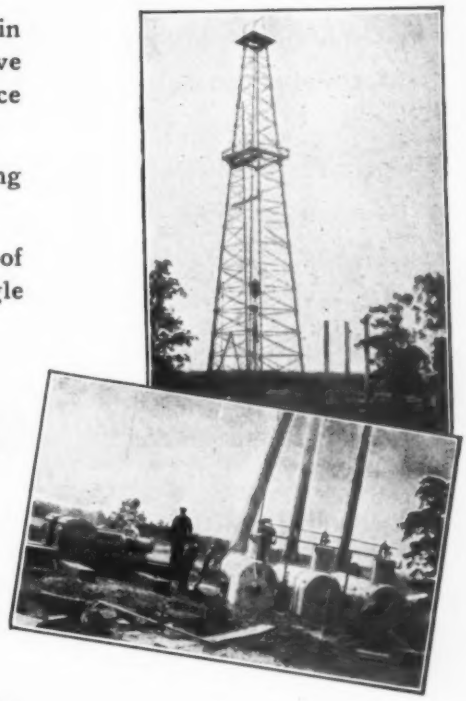

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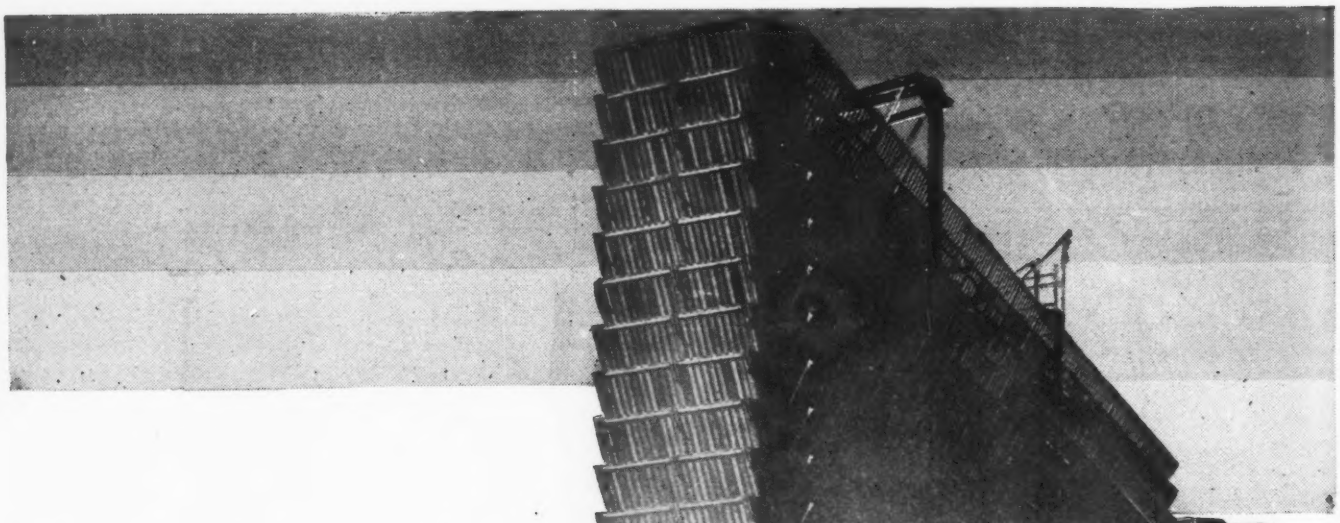

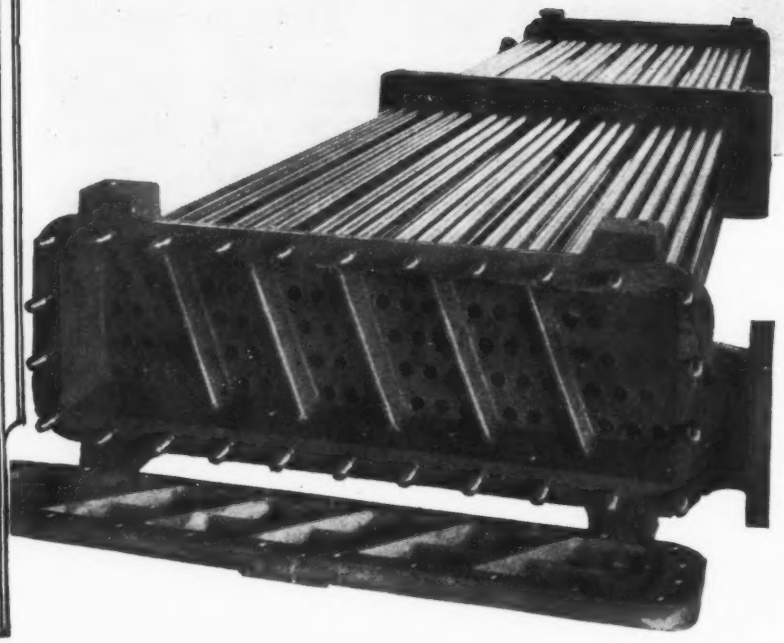

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heaters will not be attempted in this paper, as many of the various details are variable depending on the equipment available and the particular characteristics of the oil being treated. At this point, it is well to stress one safety factor regarding the use of boiler heaters fired directly with gas or other fuel. An extra connection should be provided connecting the bottom of the boiler with the bottom of the flow tank or settling tank. The higher head of fluid in the flow tank will cause the boiler heater to remain filled with water, the incoming cut oil passing through this hot water and out the top of the boiler heater. In the event of sudden leakage, the fire hazard is greatly reduced, as the greater part of the leakage will be composed of water.

Facilitating Water Separation

After passing through the heater or in those cases where the flow tank is used as a heater or where no heat is required, the oil should then be passed through a flow tank or settling tank, or preferably both. The object of these tanks is to allow the free water to settle out of the oil, so that only clean dry oil is taken over to stock. For the most efficient results, the incoming oil should be introduced at the bottom of both the flow tank and settling tank, to eliminate conflicting currents and allow no new water to be introduced at the top of the tank. Most efficient results are obtained by introducing the incoming oil through a flume extending within a few inches of the bottom rather than through a direct connection at the bottom of the tank. This flume enables any free gas left in the oil to become separated without bubbling it up through the oil. The greater part of the water can be drawn off from the flow tank, or gun barrel as it is sometimes called, the remainder being drawn off from the settling tank. The use of a flume in the settling tank is not essential as practically all free gas has been removed, so the oil can be introduced at the bottom through a connection extending to the middle of the tank. Better separation of the water will be effected by using baffles in the settling tank, causing the oil to travel a greater distance in the same vertical height, thereby allowing more time for the separation of the water. If these baffles are so arranged as to allow the water accumulated by each baffle to be drawn off (see diagram) the same effect is obtained as that of using several settling tanks, as the oil in the lower part of the tank can settle its water and will not be receiving water from above as in an ordinary settling tank without baffles.

Use of Excelsior Tanks

On those oils where it is advantageous to use excelsior tanks, the settling tank is utilized as an excelsior tank, the space between the various baffles being closely packed with excelsior. As it is essential to keep the water level below the excelsior, the water level should be controlled by an automatic float control valve, as the ordinary siphon control is not adaptable to the maintenance of a very low water level.

The use of these excelsior tanks has eliminated on many oils the necessity of heating, with the resultant saving in fuel expense and also added value of the oil due to saving of gravity. There are many types of oils where the emulsion can be easily broken without the use of heat, but due to small difference of gravity between the oil and the water, the water will not settle freely except by heating. It has been found that the passage of this broken emulsion through excelsior results in the coalescence of the water droplets into large volumes which separate readily from the oil.

The use of excelsior is not practical for all oils, as there are many oils which require heat for the successful and economical action of the chemical, and many of these oils drop the water readily once the emulsion is broken.

Tracing Sources of Treating Troubles

The preceding discussion deals in a general way with the various steps in the process of treating by the most approved type of treating plant. Assuming that the plant has been installed and placed in operation, it sometimes happens that the oil suddenly shows up bad in the stock tanks. In tracing down the cause of this, it should be determined whether the oil contains B. S. or free water as explained above. In case B. S. is found to be present in the oil, the trouble can usually be traced back to the improper feeding of chemical or to some decided change in the amount of fluid being produced or in the nature of the emulsion. A considerable saving can be made by careful proportioning of the amount of chemical to the production of the well rather than to spasmodic measurement of the chemical being introduced.

In the event that the oil is showing free water the trouble can probably be traced to the accumulation of water in the flow tanks and settling tanks or to the improper regulation of temperature if heat is being used.

On small wells, it is sometimes found more convenient to treat the cut oil by means of batch treatment or tank treatment. Treatment by this method involves the correct application of the same principles outlined above; equal distribution of the reagent throughout the oil being treated, proper temperature and sufficient agitation, together with sufficient time for settling after the emulsion has once been broken. Agitation is usually accomplished be means of circulation with a pump or by allowing gas to blow through the tank. On wells producing large volumes of free water and only small amounts of oil with a fairly low percentage of B. S., this method of treatment is sometimes more economical than the continuous line treatment, as the greater part of the free water can be separated before treating, thereby reducing the amount of fluid to which the treating agent must be added.

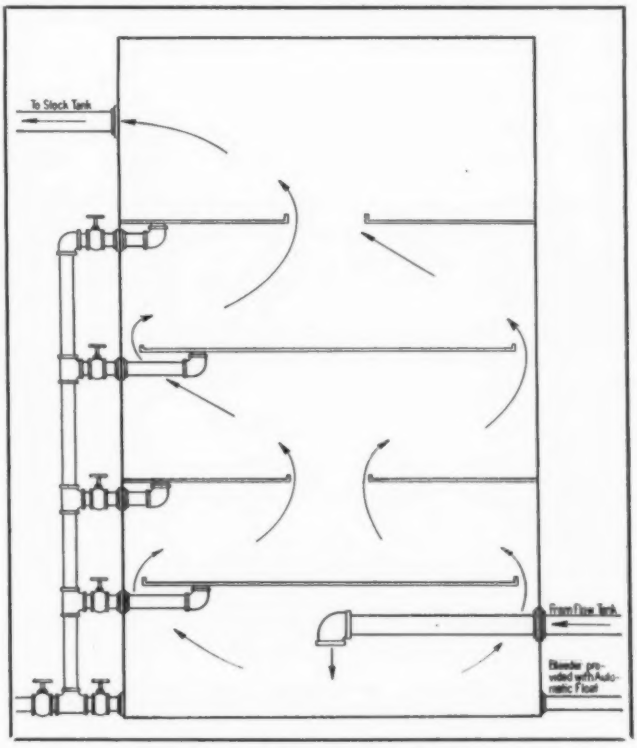
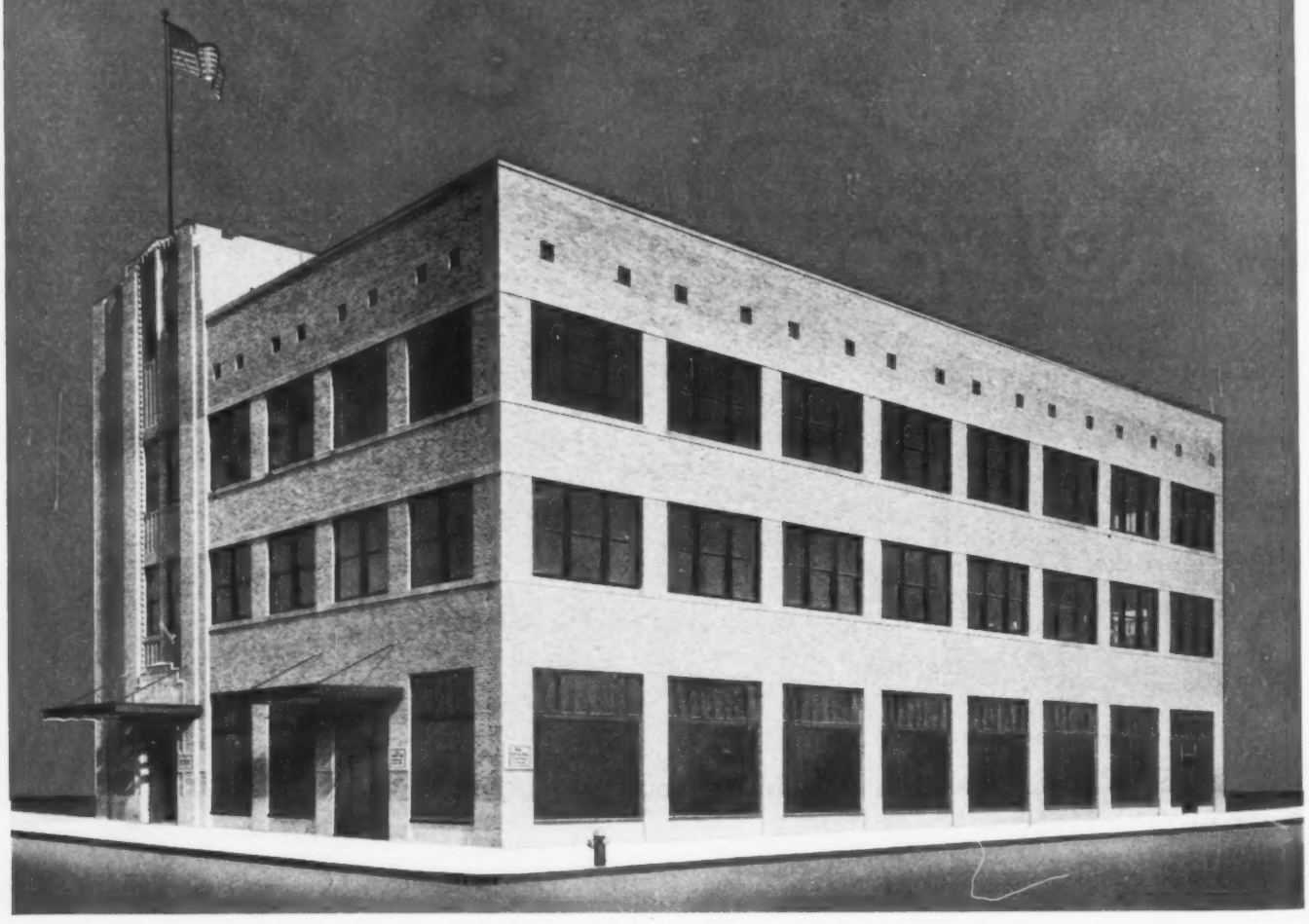


Diagram of model settling tank.

Turn to Page 64 Please

The NATIONAL at TULSA



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Preventing Formation of Emulsions

One of the newer ideas in oil treating practices is to "prevent" the formation of the emulsion rather than to break down the emulsion after it has already been formed.

"Prevent" is used in the sense that the fluid is *delivered* substantially as oil and water, and contains no emulsion at that time. The fact is that an unstable, temporary emulsion has probably been formed in the presence of the chemical, but has been readily resolved in the well or in the line, and so does not exist at discharge. It is a definitely established fact that emulsions as such do not occur in the producing formation, but are formed either in the well itself or at the restrictions used to hold back pressure on the well. In those wells where the bottom hole pressure is sufficiently high to cause Artesian flow, the emulsion is not formed until the oil and water pass through the various chokes or pipe restrictions on the surface. Introduction of the chemical into the well before passing through these restrictions will usually "prevent" the emulsion being formed. Separation of the water by means of high pressure traps installed in front of the choke will also prevent emulsification. The introduction of a small amount of chemical preceding the high pressure trap usually gives more efficient results with extremely low treating costs (see diagram for high pressure trap installation.)

Another method of "preventing" the formation of the emulsion is known as the Brady process, or "Down-the-Hole" Method, the patents on this process being controlled by Wm. S. Barnickel & Company, who manufacture chemical treating agents under the general trade name, "Tret-O-lite." This method is applicable to pumping wells, gas-lift wells, or wells flowing naturally through tubing where the casing head pressure is not too high to prevent introduction of the chemical.

Best results are obtained by making up the chemical into a very dilute solution, as this allows easier and more complete distribution of the chemical through the fluid. On gas lift wells the solution is lubricated directly into the gas input line, passing to the bottom of the hole with the gas and back out with the fluid. In such cases, the fluid produced consists of clean oil and free water with no emulsion or B. S. It is then necessary to provide only sufficient equipment for the separation of this free water from the oil. On pumping wells, the solution of chemical is lubricated into the well between the tubing and casing, passing down to the bottom of the hole and up through the tubing with the oil. In many cases with pumping wells, continuous lubrication is not necessary, as the introduction of the chemical at intervals varying from several hours to several days will suffice. This method of treatment not only gives lower treating costs but also materially aids production on gas lift wells by lowering the necessary input pressure, as the unemulsified oil and water is much less viscous than the corresponding emulsion, and can be lifted with lower pressures.

The foregoing discussion is not intended as an outline for the construction of any individual treating plant, as the individual character of the different emulsions encountered prevents any one universal procedure being followed. The basic principles outlined above applied in connection with actual treating experience will result in the correct type of treating method being selected at the start. It sometimes seems that the installation of the proper equipment for treating involves an excessive and unnecessary expense, but with the lower treating cost per barrel obtainable with the correct type of plant, this initial expense will soon be charged off and the final total expense will be much less than where an attempt is made to treat with improper equipment.

Sixth International Petroleum Exposition Will Be Good Show

THE Sixth International Petroleum Exposition which will be held in Tulsa, Okla., from October 5 to 12, has been termed the place "where men, methods and machinery meet" by Wm. B. Way, general manager of the show.

Mr. Way, who for many years directed the annual expositions of the Natural Gas Association of America, is serving his first year in charge of the Tulsa show. Under his direction the show this year promises to be the most interesting ever held. It will have exceptional interest and benefit to the superintendent and man in the field, and at

a glance he may observe every type of petroleum equipment used in the production, transportation and manufacture of petroleum and its products.

The genuine value which the oil companies place upon the show may best be explained by the fact that the majority of companies urge their field employees to come in from the fields and visit the exposition. Many companies arrange for their field men to relieve each other in order that they may make a trip to Tulsa and visit the show.

In addition to the hundreds of exhibits, there will be several important technical, executive and scientific meet-

ings held at the same time as the exposition, and a meeting of the directors of the American Petroleum Institute will be held October 4, the day before the show opens.

The American Institute of Mining Engineers (petroleum section) will meet during the show, and many matters of interest to the technicians will be discussed there. The Oklahoma-Kansas district of the A. P. I. division of development and production engineering will hold its fall meeting October 6 and 7 at Tulsa, and an interesting program pertaining to many subjects of current interest will claim the attention of the members of this division.

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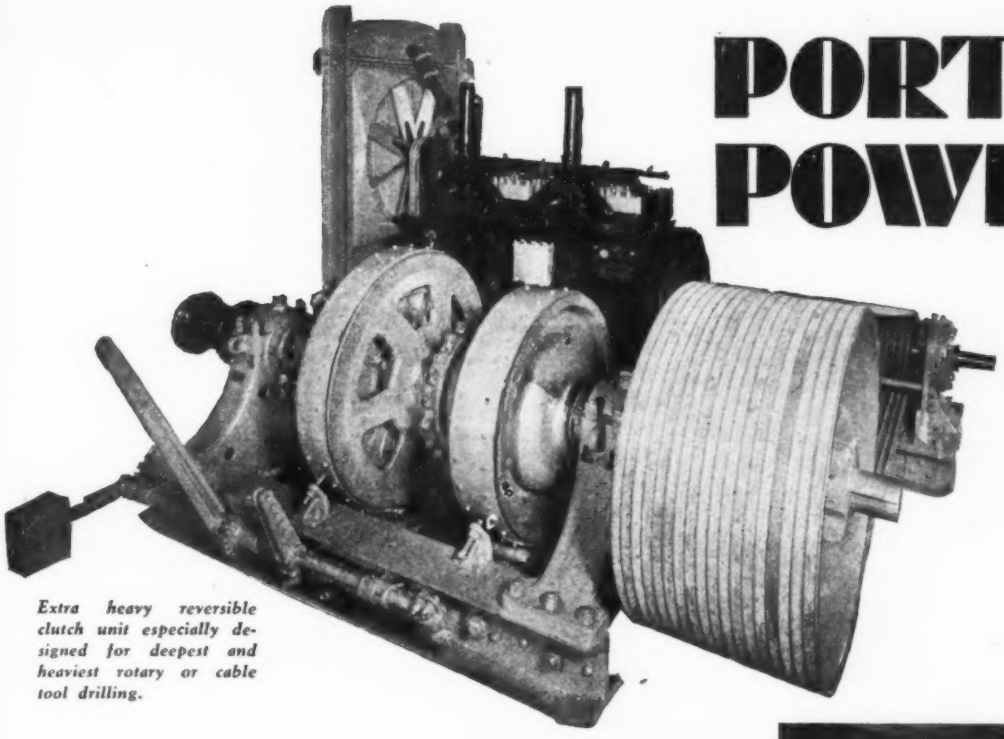

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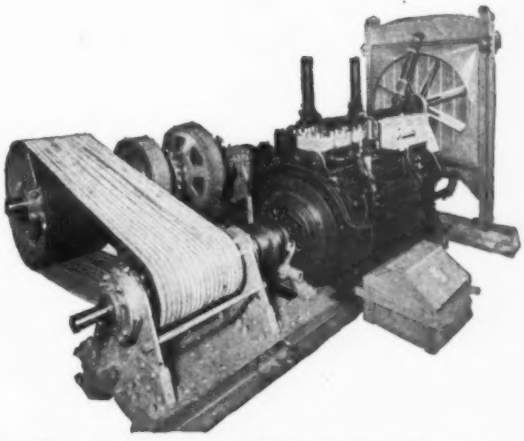
The enormous saving made in cost of operating this PORTABLE RIG as compared to steam for deep drilling immediately recommends it for rotary or cable tool operations.

This Portable Rig requires only about half the time to set up or move from one location to another and it may be operated on natural gas or gasoline, the consumption of either being very small. Thus, it is possible to effect a very material saving in operating expense over a steam rig. There is an additional saving in water and fuel oil as the amount required to operate the Portable Rig is considerably less than that required for a steam rig, thus making this rig particularly adaptable for wildcat or isolated operations.

This type rig has all the flexibility and power and readily compares with any steam rig. For more detailed information on this rig write for bulletin.

Waukesha Great Six engine (300 H.P.) driving largest Mud Hog slush pump.



Close up rear view of Waukesha Great Six and Portable Reversible Clutch Unit Showing Texrope drive.

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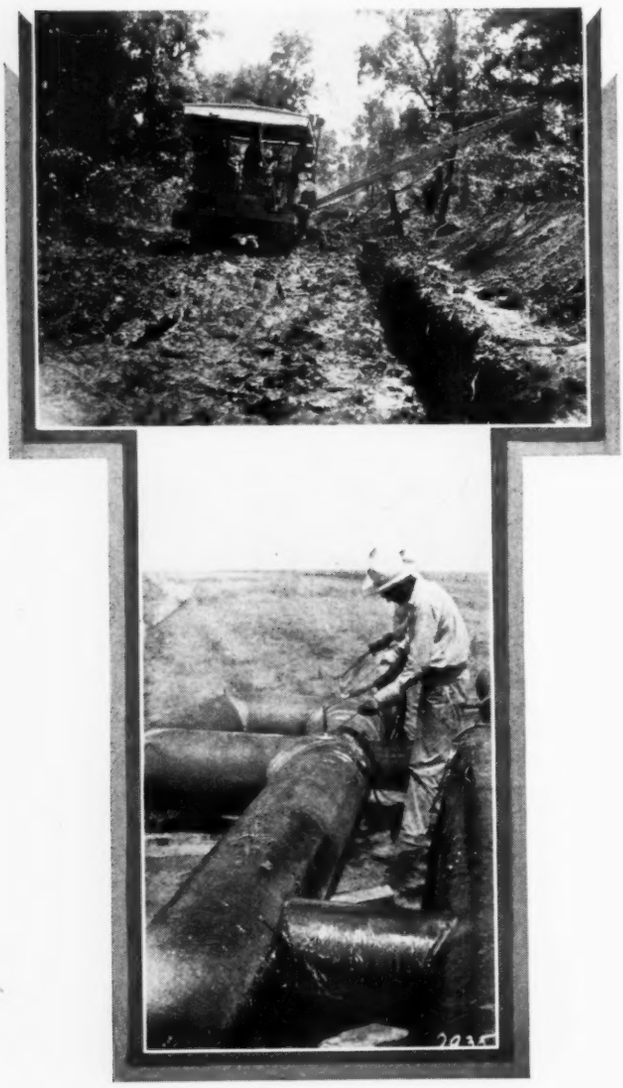
Holding Protective Paints *in* Place



Above—Tractor boom and drag-line for backfilling. Below—Welding an interesting special in Oklahoma. The latter picture furnished by Linde Air Products Co.

SEVERAL different methods to prevent protective coatings from sagging or checking are being used by various companies in the construction of main line transmission systems and "white washing" seems to be the most universal method in protecting line coatings from the above described perils. However, aluminum mixed with paint is being experimented with and showing good results.

On new construction work many gas companies are making an economical whitewash from carbide residue that is turning the trick. The residue is taken from the gas generators and thinned, then applied to the line with common pipe line paint brushes.

Whitewash made from lime is being used on the 22-inch gas line being built from the Monroe field in Louisiana to Birmingham and Atlanta. Experiments are being made to determine what the chemical reaction of the lime and water is when in contact with the paint chemicals. While this method of reflecting the sun rays is economical, the application is somewhat different from that used by the Lone Star Co. Whitewash is painted over the entire outside surface of the pipe while it is only applied on the top and sides on the Texas line.

Many interesting experiments are also being made on the gas line being constructed for the Mississippi River Fuel Co. by the Williams Brothers Co. Some of the above pictures are displayed through the courtesy of the Williams organization, and show the use of this whitewash on the St. Louis line.

Oklahoma Natural Gas Corp. is experimenting with aluminum. It is mixed with the primer coat and applied to paint that is to be kept in the yard for any length of time. It also is used in the paint on line construction. So far the results have been satisfactory and yard pipe painted thusly has not shown signs of checking.

Tractor boom handling 40-foot joints of gas pipe.

Scenes showing whitewashed pipe on the Louisiana-to-St. Louis gas line. Photos furnished through courtesy of Williams Brothers Company, pipe line contractors.

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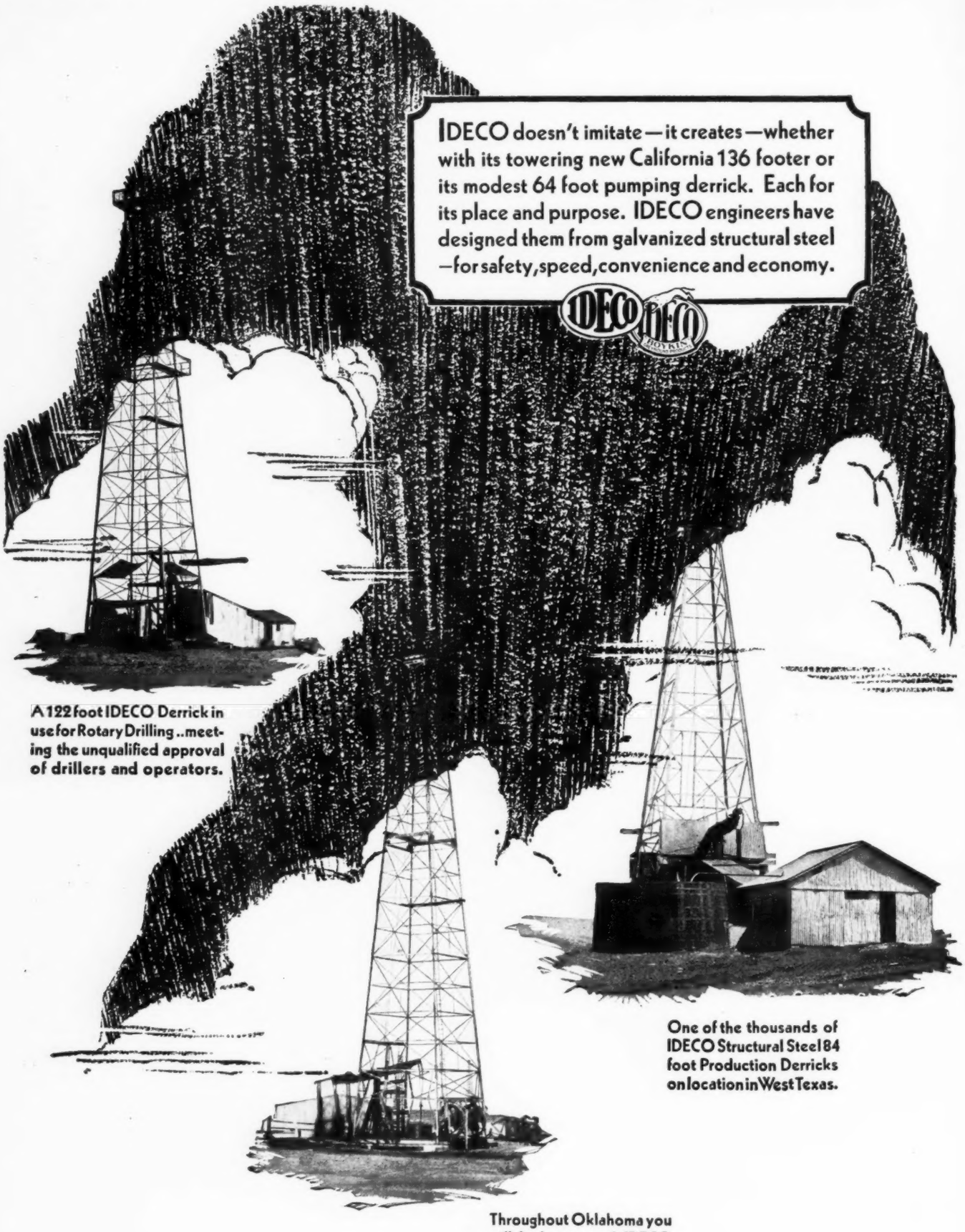
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USE OF GRAVEL *in* WELLS GIVES

Information on Results of Shooting

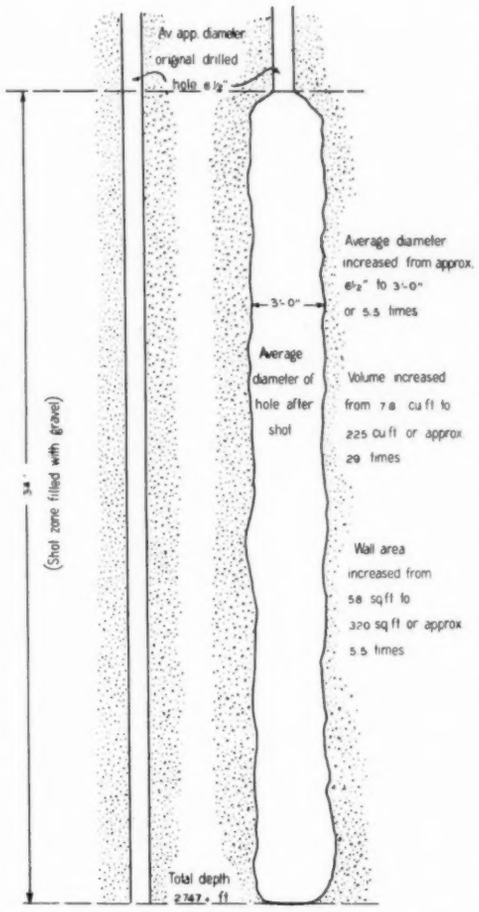
WHEN pumping wells are shot in an effort to increase production, they often become a source of trouble and expense due to caving and "sanding up". The increase in revenue from the extra production obtained is not always sufficient to offset the increased well operating costs that result and the shooting operation, instead of showing a gain, becomes a source of financial loss.

In its Kansas wells, the Empire Company has been successful in eliminating these troubles which follow shooting by filling with gravel the cavity formed by the shot.

After the well is shot and cleaned out, just enough gravel to fill the shot hole is dumped in the well. A perforated liner is then set on top of the gravel and the drilling tools run inside the liner. It should be noted that the real function of the drilling tools in this operation is to displace, rather than crush, the gravel just sufficiently to allow the liner to follow the tools down until landed on bottom. This is easily accomplished as the gravel is loosely packed.

Clean, well-screened gravel, varying in size from ½ inch to 2 inches, depending on well conditions, is used. Gravel composed of flat, irregular-shaped pebbles, with a smooth surface, is preferable, because of the greater interstitial space that can be obtained, and also the minimum resistance to flow it offers.

Shot hole wells that previously had a lot of pump trouble due to sand and cavings, necessitating frequent tubing and rod jobs, now operate for long periods without a shutdown. Not only does the method eliminate well-operating difficulties, it is also a means of obtaining valuable data on the efficacy of shots in different sands. Data on six wells before and after shooting are given in the table below.


Av. app. diameter original drilled hole 6½"
Average diameter increased from approx. 6½" to 3'-0" or 5.5 times
3'-0"
Average diameter of hole after shot
Volume increased from 7.8 cu ft to 225 cu ft or approx. 29 times
Wall area increased from 58 sq ft to 320 sq ft or approx. 5.5 times
34'
(Shot zone filled with gravel)
Total depth 2747 ft

The effects of 100-qt. shot on Bartlesville sand well in Kansas as estimated by gravel method.

On each well an estimate of the space volume before and after the shot is made. The space volume before shooting is obtained from the size hole drilled, and after shooting, from the amount of gravel required to fill the shot hole. From the space volume after the shot, the average wall area of the shot hole is computed. Thus, in addition to the amount of space volume increase, the method yields information on the average wall area increase. In tight sands an increase in average wall area may be an important factor in increasing the rate of production.

Ordinarily, the effect of a shot on the walls of an old producing well is evaluated in terms of the amount of the old face of the sand, with clogged pores, that is removed, rather than the increase in wall area that results. A more accurate appraisal of shot results is possible by taking into account increase in wall area, which information this method yields.

It should be noted the wall area varies only as the diameter of the hole while the space volume varies as the square of the diameter of the hole.

SHOT HOLE DATA

Well Depth	Producing Sand	Length Shot	Qts. Foot	Kind of Shot	Diam. Tools	Dimensions of Zone Graveled Before Shot: Length	Before Shot: Est. Vol. Cu. Ft.	After Shot: Av. Diam.	After Shot: Vol. Cu. Ft.	Ratio of Increase By Shooting: Space Vol. Cu. Ft.	Ratio of Increase By Shooting: Wall Area
726′	El Dorado Shallow	(1) 15′	(1) 1.3	Solidified 100% O. W. E.	6¼"	17′	3.9	2.7′	96	24.6	5.0
		(2) 15′	(2) 1.0	Liquid Nitro							
2747′	Bartlesville	25′	4.0	Solidified 100% O. W. E.	6¼"	34′	7.8	3.0′	225	28.9	5.5
2757′	Bartlesville	23′	4.3	Solidified 100% O. W. E.	6¼"	24′	5.5	1.8′	59	10.7	3.3
2751′	Bartlesville	31′	3.5	Solidified 100% O. W. E.	6¼"	37′	8.5	2.6′	202	23.7	4.8
2761′	Bartlesville	21′	4.3	Solidified 100% O. W. E.	6¼"	26′	6.0	2.6′	141	34.5	4.8
2703′	Viola Lime Silica Sand	63′	1.6	Solidified 100% O. W. E.	6¼"	70′	16.1	2.2′	256	15.9	4.1

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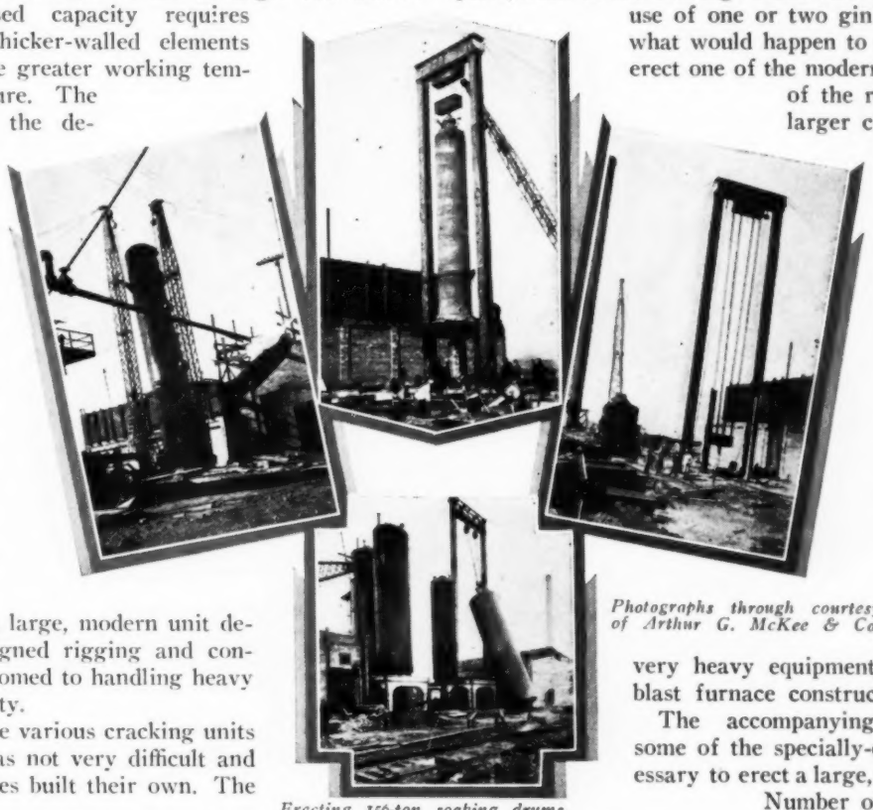
Difficulties Encountered in

Erecting Heavy Refinery Equipment

THE continuous development of cracking units of increased capacity, and higher temperatures and pressures naturally results in the use of larger and heavier equipment. Increased capacity requires larger units, and thicker-walled elements must be used for the greater working temperature and pressure. The soaking drum and the dephlegmator required on the large installations are many times the weight of the older type. On some of the successful cracking units the soaking drums weigh as much as 156 tons, and as their weight continually increases the problem of safely erecting them becomes more difficult. The successful erection of a large, modern unit demands specially-designed rigging and construction men accustomed to handling heavy equipment with safety.

The erection of the various cracking units in the early days was not very difficult and many of the refineries built their own. The weight and dimensions were only a fraction of some of the present-day units. It was possible to erect any of the various parts, such as the soaking drums and dephlegmators, by the use of one or two gin poles. It is evident what would happen to a gin pole if used to erect one of the modern heavy units. Many of the refineries building the larger cracking units operating under high temperatures and pressures did not have in their organizations men with experience in the design of rigging for such equipment and experienced in the safe erection of the very heavy elements. The result was that the construction was contracted for with engineering companies experienced in the erection of very heavy equipment, such as is used in blast furnace construction and the like.



Photographs through courtesy of Arthur G. McKee & Co.

Erecting 156-ton soaking drums.

The accompanying illustrations show some of the specially-designed rigging necessary to erect a large, modern cracking unit. Number one shows the erection of 10 ft. x 40 ft. soaking drums. These drums are specially welded and have two-inch walls.

The accompanying illustrations show the construction equipment used for erecting a 156-ton soaking drum. Rigging of this size involves considerable engineering work and experience that is not usually maintained in the refinery organization. The rigging used in this case is similar to that illustrated in the top picture, but it is necessarily much heavier and in the design of it special attention had to be given to the head blocks and to the winches that were used on the two lines for hoisting these heavy drums. The picture on the left shows the erection of a larger vessel with the use of two gin poles designed for heavy construction.

The A. O. Smith Corp., of Milwaukee, Wis., has made exceptional progress in the manufacture of cracking stills and other heavy refining apparatus.

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AFTER severe tests under practically every drilling condition known to the fraternity, we offer "The D-H Wire-Line Lubricator" and "INSULINE No. 269" as a most thorough and effective means of lubricating wire-lines.

Lines lubricated in this manner are absolutely protected clear to the core. Running in sulphur, alkaline or salt water—running in sulphur crude oil—or spooling indefinitely — will not cause strands to crystallize and break when they have this protection.

This lubricant also eliminates cut casing in crooked holes, by furnishing the line with a protective cushion. It is applied while running lines in or out of the hole.

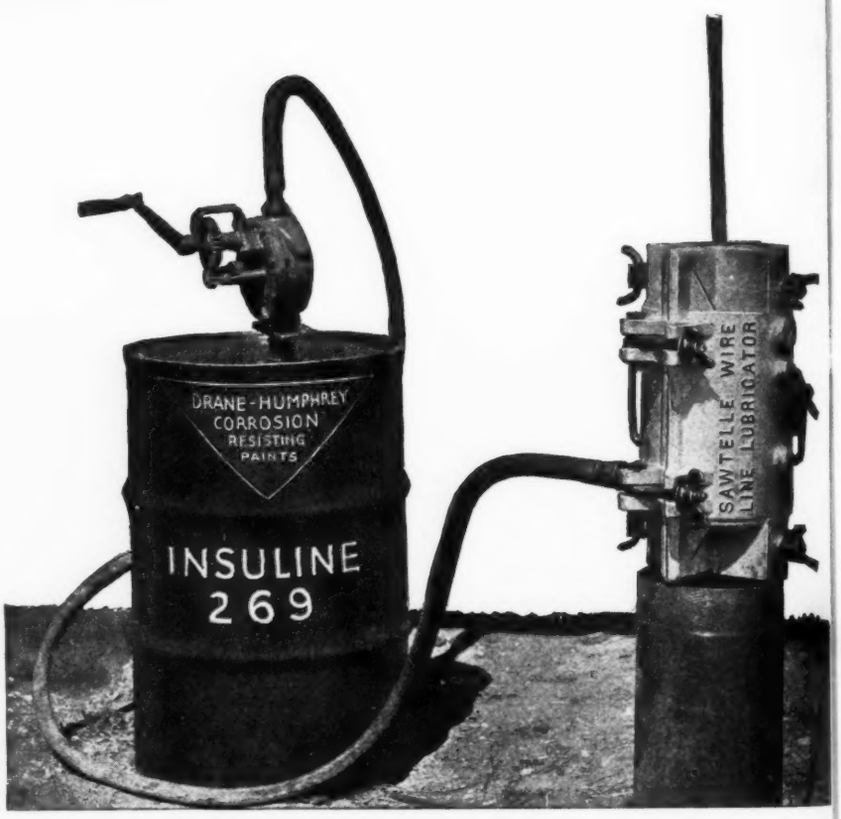

Photo of tank of "INSULINE No. 269," with pump and "D-H Lubricator" assembled for operation.

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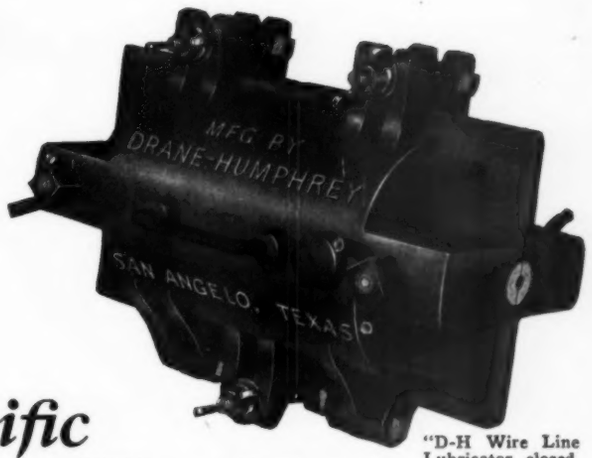

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—You KNOW the thousands of dollars every job costs you on this item ALONE!

"D-H" Wire Line Lubricator, open.

INSULINE No. 269 has wonderful heat-resisting and penetrating qualities. At a pressure of 2½ lbs. it thoroughly saturates the core, and coats the strands of a wire line, in four-fifths of the time required to do the same work with the finest petroleum oils.

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Complete Equipment for Applying (as shown in photo on opposite page) and 55 gallons of INSULINE No. 269 (enough to treat 30,000 feet of line) only

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The Importance of Lubricating Wire Rope

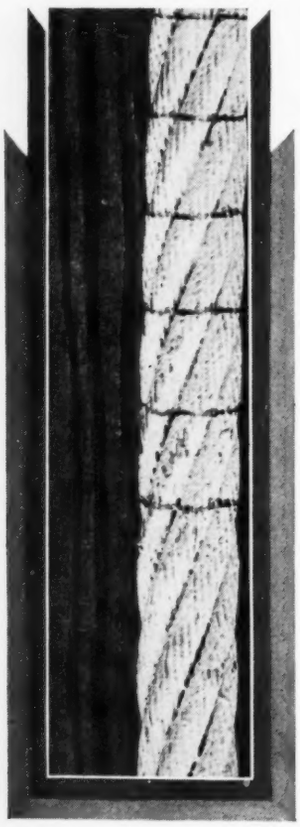
By **M. G. ENSINGER,**
Vice President Union Wire Rope Co.

MANY users of oil country wire rope do not realize the importance of lubrication. If it were possible to trace directly all rope failures due to lack of suitable lubricant the figures would be astounding. Not only would many fishing jobs be chargeable to lack of lubrication, but shut-downs and accidents also. The driller usually asks, "how could the lack of lubrication cause the many troubles that are charged against it?"

If the user would only consider that in a 6 by 19 rope, there are 114 wires, and a hemp core or heart, or 115 working parts in all, the necessity for lubrication would be more evident. There are usually three wire sizes in the oil country Warrington type construction. Wire tolerances as set forth in the A. P. I. Specifications for wire rope are as follows:

Wire size	Total variation under
.064 and larger	.004
.064 and smaller	.003

Most manufacturers conform to a smaller variation than that specified. Every one of these parts must be free to work in order that each wire may absorb its proportionate share of the shock received from the load, transmit it throughout the length of the rope and not in any one spot.



Note that each mark is continuous when rope is straight.

"Rust-Bound" Rope

It is comparatively easy for the field man to observe that a rope is in need of a lubricant by noting the following characteristics: creaking noise while the rope is spooling (may also indicate a bad water condition); breaking of the wires in the valley of the rope without any indication of uniform strand nicking; the spring of the rope lessening without the lay being pulled down noticeably. The cable tool driller expresses the latter condition by saying "this line is drilling like a string of sucker rods" (meaning, it has no elasticity or spring). He does not realize that corrosion or rust has caused his rope to become what rope men term "rust-bound." This condition causes a rope to be stiff and inelastic. When a "rust-bound" rope receives a sudden jerk it cannot absorb the shock of the load throughout its length; instead, the brunt of the shock is confined to one spot and results in the breaking of one or more strands, and occasionally, the entire rope.

Quite recently a very rusty 20 foot piece of 7/8-inch 6 by 7 Left Lay Cast Steel drilling line, considerably worn, was returned to the factory for examination. Two adjoining pieces, each six feet long, were cut from this sample and socketed for the ultimate or breaking strength test. One

(Turn to page 79, please)

When rope is bent, marks become a series of disconnected lines, demonstrating how slipping occurs between strands.

sample was left in the rusty condition in which it was received, the other was thoroughly soaked in a thin engine oil. Here are the results of the test:

	Ultimate Strength	No. strands broken	Stretch per cent
Rusty piece of rope.....	29,700 lbs.	2	.98
Oiled piece of rope.....	40,840 lbs.	3	1.45

The increase in both ultimate strength and stretch of the oiled piece over the rusty piece of rope is convincing evidence of just what lubrication means to a wire rope.

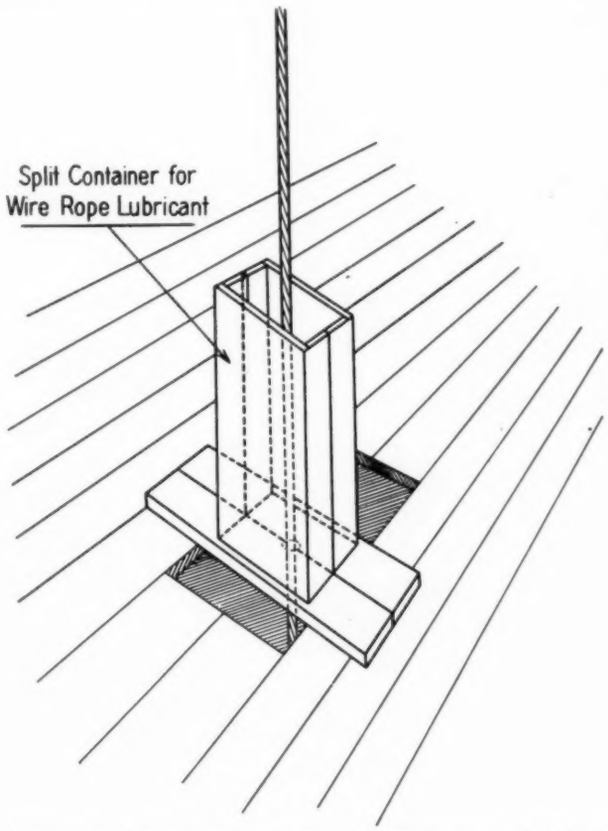
Figures 2 and 3 are presented to show that the individual strands and wires of a wire rope must function as movable parts within the rope itself while in service. This practical illustration is conclusive proof that adjacent strands must change their position with respect to each other, and applies also to the individual wires. If a wire rope is corroded or rust-bound rope it is denied this necessary freedom and, as already pointed out, will result in broken wires and strands. Lubrication will help prevent this condition and save many unnecessary shut-downs, accidents and fishing jobs.

If a rope is allowed to become dry, corroded or rusty, and the sheave in which the rope is running is in a similar condition, it will cause the rope to slip. This slipping over the sheave abrades and cuts the rope and reduces its metallic area and therefore, its strength. It also has a tendency to unbalance the rope. An unbalanced rope usually develops high or tight strands. Dry rope will create more friction and produce more sparks than lubricated rope, thereby increasing the fire hazard on gas and oil producing wells.

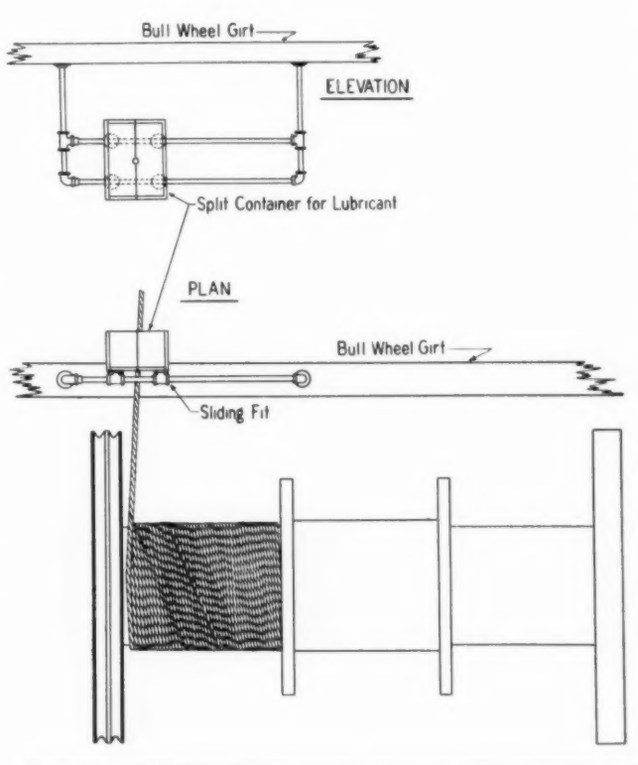
Lubrication Trebles Life of Rope

It is stated that lubrication will increase the life of a rope two or three times its normal life if dry. Such results are obviously due to reducing the cutting action of the wires upon each other. Some tests made in 1890 by Biggart of England show very strikingly the value of lubrication to rope service. Some of his results are quoted below:

Sheave Diameter	17.5d	42d	Ratio by Diams.
DRY Rope.....	10,000 bends	74,000 bends	4.6
LUBRICATED Rope....	38,700 bends	386,000 bends	10.
Ratio by Condition.....	2.4	5.2	.....



Simple type of wire rope lubricator which can be set on derrick floor.



Wire rope lubricator made of pipe and small fittings mounted on bull wheel girt.

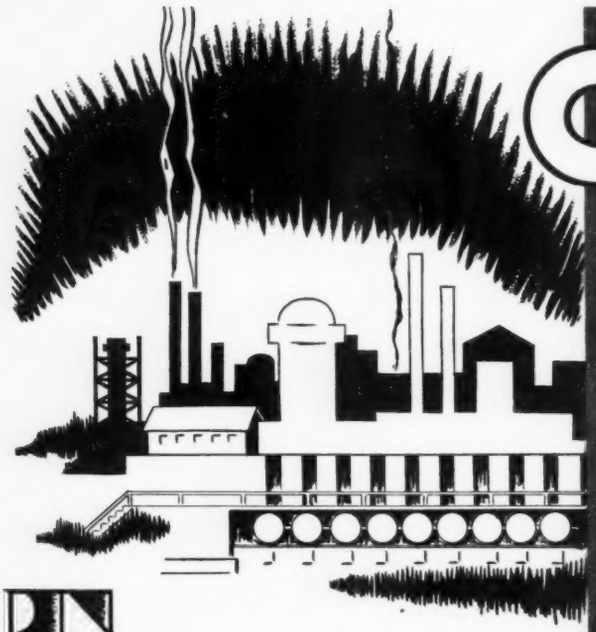
Prevent Deterioration of Core

The heart or core of oil country rope is usually of hempen fibre. Being of vegetal origin it is subject to comparatively rapid physical and chemical deterioration, especially when in use, particularly so in corrosive or deteriorating elements.

Physical deterioration of the core starts immediately a rope is put in service. Even a slight axial stress or pull on the rope causes compression of the core and forces out some of the core lubricant. Combine axial with bending stresses and the core is compressed to a much greater degree. Also at the same time it is subjected to chafing caused by the steel strands sliding on the core to accommodate the radius of curvature and then back again to a straightened position when leaving the sheave or drum. Combine now these high compressive stresses and chafing of the core with the action of brine or sulphurous fluid from the well and some idea is had of the necessity of a lubricant for preservation of both hemp and steel. It is said by many that the life of the rope depends upon the core. The function of a core is somewhat similar to that of any bearing, for in reality it acts as a bearing for the strands of wire wrapped around it.

The core, as well as the entire rope, is thoroughly lubricated in the factory by special compounds and methods which give the new rope ample lubrication to last through a period of storage (if storage is not too long), and while being broken in after the rope is put into use. It should be understood that this initial lubrication will not last for the life of the rope. If lubrication is neglected the hempen core will become dry and lifeless, and deteriorate or rot. After the

(Turn to Page 81, please)



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Other Crosby Safety Valves designed for pressures up to 1500 pounds, and temperatures up to 800 degrees.

STYLE JJ CROSBY RELIEF VALVE

This is a non-sticking, non-fouling, valve, smooth in operation and positive in action. Provides maximum discharge capacity—98% of theoretical discharge of orifice.

Other Crosby Relief Valves designed for pressures up to 16,000 pounds per square inch.

CROSBY Nozzle Type Pop Safety Valves and Relief Valves are standard for all pressures up to 1500 lb. gage, and 1000 deg. F. They are deservedly popular throughout the petroleum industry because there is a style developed to meet the requirements of every class and condition of service, and because these valves are designed to function satisfactorily with a minimum maintenance cost.

CROSBY Screwed Tube Pressure Gages, double-tube and single-tube type, are specified by leading designing Engineers for modern conditions.

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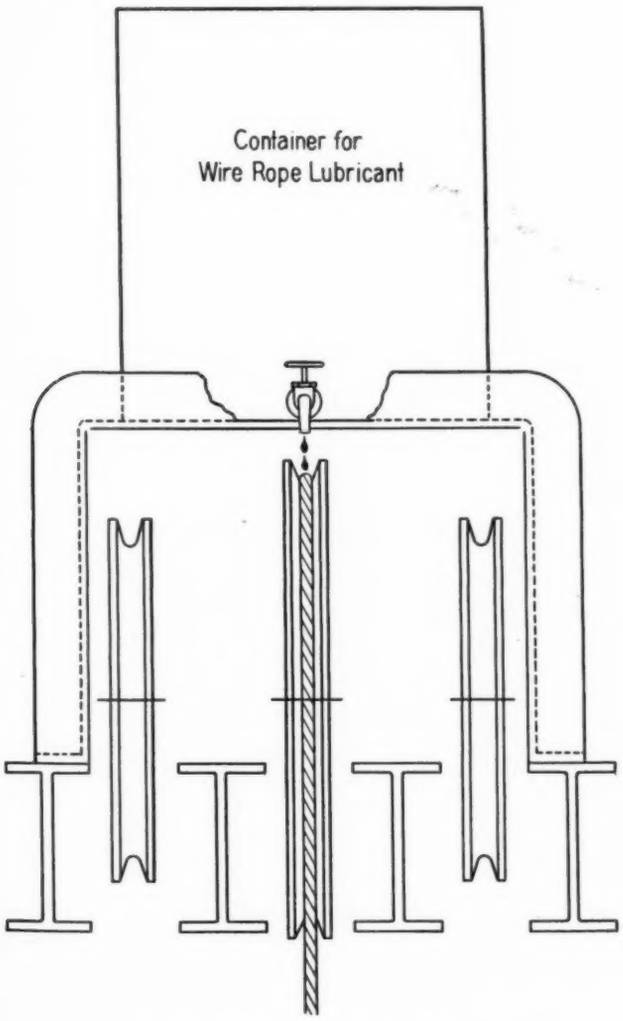
core no longer functions as the bearing for which it was originally intended, the lay of the rope pulls down rapidly, causing the strands to rest against the adjacent strands, then when a load is applied, strands cut adjacent strands and eventually rope failure occurs.

Application of Lubricant

Just how long the initial lubrication remains effective, is governed by various factors which become a matter of individual judgment, hence no fixed rule can be laid down. If the rope is used immediately upon receipt from the factory, then the condition of service will largely determine how soon the rope should be lubricated. If the rope is used mainly as a cable tool drilling line, for swabbing, for cleaning out, or similar work where the line goes into the hole, the nature of the fluid will have some bearing. If the fluid is a brine or has acidity, it will be advisable to lubricate within two or three days after installation of a new rope. This is also true for rotary lines, due to the heavy duty, high speed, and severe bending to which they are subjected. Ropes under such condition should be lubricated regularly once or twice a week depending upon the severity of the service. The heavier the duty, the greater the number of bends, the higher the speed of operation, or the more corrosive the fluid, the more frequent should be the lubrication. If a rope remains pliable, with evidence of lubrication in the valleys or crevices between the strands, it does not require such frequent lubrication.

If a rope has been in storage for a considerable time it is advisable to lubricate it during installation. It is considered more practical and economical to lubricate a rope without removing it from the rig. There are a number of appliances for this purpose. Several such appliances that are deemed practical are shown in the accompanying illustrations.



Wire rope lubricator mounted on crown block.

Properties of a Good Lubricant

Crude oil should not be used for rope lubrication, as it contains impurities that are detrimental to both core and steel. For cold lubrication a medium cheap engine oil is very good. Several concerns specialize in commercial chemically neutral rope oils of various consistencies. A compound of medium consistency should be used for cold lubrication with proper equipment for lubricating. It is better to use a compound that has to be applied hot. The lubricant should be applied while the rope is under as light a load as possible. A rope lubricant should have the following properties:

1. Ability to adhere and resist wiping off.
2. Ability to penetrate.
3. Ability to form a coating for both the core and wire which will keep out moisture and other detrimental elements.
4. Ability to lubricate and also preserve.
5. Freedom from any deteriorating properties, usually chemical, which would be harmful to either the core or steel.

Wire rope can be laid up in a lubricant in the shop and kept in sheltered, ventilated storage for three or four years without any deterioration. Such a protective coating however, would be objectionable to handle by the user. This objectionable feature is also the reason why oil field ropes are hardly ever sold with heavy external lubrication. The internal lubrication of oil field ropes should be such, however, that the rope can be stored in sheltered ventilation with only a surface oiling perhaps twice a year to prevent surface rust, and to make up, with a lighter oil, for what the summer heat may have volatilized. If stored outside, the reels should be set up at least a foot off the ground on blocks, the ground kept clear of grass and weeds and the entire reel covered for protection from the weather. Wire ropes stored away in this manner should be examined every three months for any indications of surface rust, and oiled with a brush if necessary. As the core lubricant is liable to become somewhat dried out by summer heat, so the rope acquires a tendency to take a more pronounced set in the shape it is wound on the reel. Thorough lubrication during installation will greatly alleviate this condition.

In conclusion, it is emphasized that proper lubrication will result in less accidents, less fishing jobs, longer rope life and lower wire rope costs.

New High Pressure Drilling Value

THE Kerotest Manufacturing Company of Pittsburgh, Pa., has recently perfected a new line of high-pressure drilling valves, flow line valve and Christmas tree fittings, which have been designed and developed to meet the severe demands of the extreme pressures which are being encountered in modern deep drilling practice. The lines of valves and fittings will be known as the Kerotest Supertest, and will have a certified kerosene test of 6000 lbs. per square inch.

These Kerotest Supertest Products are built with very large factors of safety to provide for extreme shocks or extraordinary conditions. Reading from left to right, their ratings are as follows:

Type 6-S, threaded 6⅝, A. P. I. test 5000, weight 1875 lbs.
Type 6-D, threaded 6⅝, A. P. I. test 3000, weight 910 lbs.
Type 6-M, threaded 6⅝, A. P. I. test 2000, weight 575 lbs.

OLD FITTINGS *and* LEASE MATERIAL

Given New Life *in* Wilcox Plant

WITH salvage material as a starter, W. M. Garrett, traffic manager of the H. F. Wilcox Oil & Gas Co., has constructed a salvage plant at one of the company's pipe yards near Bristow, Okla., which under his supervision has effected a saving running into many thousands of dollars. It is an installation somewhat different from the average run of salvage vats.

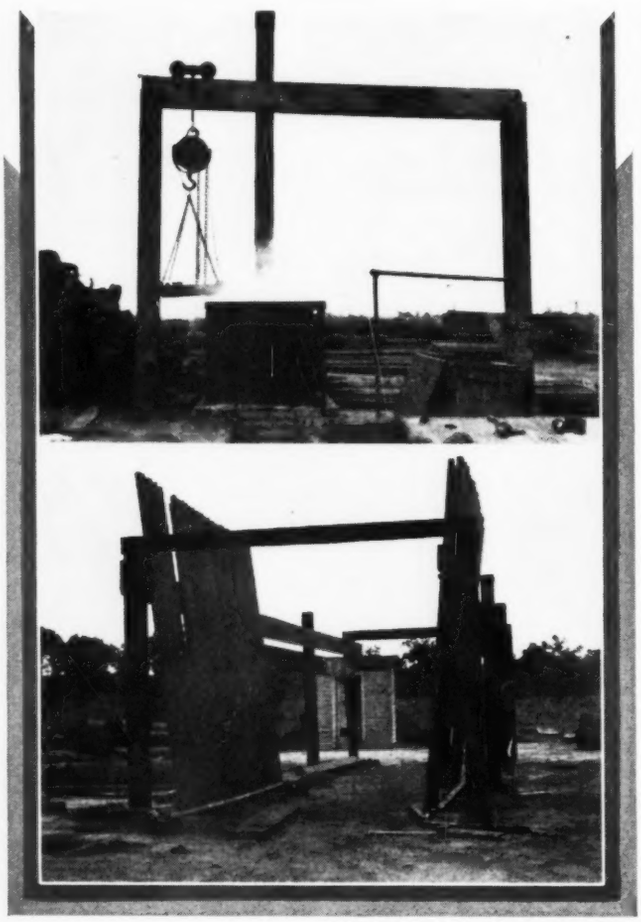
The plant was constructed from salvaged tank plates welded together into a rectangular vat nine feet long, 34 inches wide and 30 inches deep. A two-inch connection with a bull plug was put in one end for drainage and cleaning purposes. Two rings on either side of the tank facilitate lifting and moving when necessary. The fire pit, which is 20 inches deep and 12 feet long is walled in with brick and concrete and supports the vat. One end of the vat is flush with the end wall of the pit. The burner control valve is located at the other end where the extension of the pit permits freedom of movement in igniting the burner and breaking the bull plug connection to clean the vat. When cleaning the vat the fluid spills into the pit and drains off through a drain pipe leading down a hill into a ravine.

A cracked ell and a short joint of 8-inch casing was used for the flue and gives an excellent draft to spread the flame and heat. The ell was set in the foundation and the pipe screwed in upright. Fuel comes through an extension of a two-inch low pressure gas line and the fan tail burner was placed about two feet from the front of the tank bottom. The air inlet pipe is a short length of 2-inch pipe connected to the mixing chamber behind the valve.

Water for the chemical solution is supplied through a one-inch extension line off the company's water main running nearby. It comes out of the ground a couple of feet away from the front end of the tank and extends upward and over the vat. The connection is semi-rigid permitting the pipe to be swung out of the way after the tank has been filled.

To facilitate handling both fittings and connections and more bulky equipment a traveling block was built over the vat. Two old derrick sills were placed upright in the ground on either side of the vat. These were set far enough in the ground so they would not need supports to make them rigid. Two two inch by ten inch boards were nailed together and nailed to the derrick sill tops. The track for the traveling block was made of turn buckles with the ends cut off.

All of the fittings, connections or other equipment to be cleaned are placed in a tray which can be readily hooked to the traveling block and lowered into the boiling solution. When they are lifted out, whatever grime remains on them can be easily knocked off with a stream of cold water while they are in the tray.



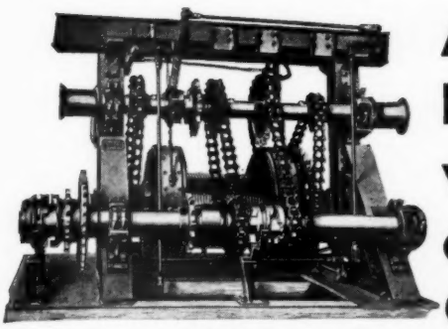
Upper picture—A tray of small fittings ready for lowering into the cooking vat. Lower—Two rows of line pipe drying after being painted both inside and out.

Ordinarily it requires about 30 minutes of cooking to remove the b. s. and rust on the connections and fittings. That which does not boil off can be readily knocked off with water, or a wire brush leaving the equipment in an excellent condition for inspection to determine whether or not it is serviceable. Those parts passing inspection are put into stock at the warehouse or sent back to wells or lines for immediate service. Those that can be brought to standard by small repairs are sent to the shop. But those parts which cannot pass muster are torn down, where practicable, and parts salvaged and the remainder relegated to the junk pile.

Some idea of how far in detail the salvage work goes may be gained from the plan of cleaning thread protectors. When these come in from the field and are found to be heavily gummed with grit and b. s. they are run through the cleaning vat. In this way sand that might otherwise cut threads has been removed whereas it may not have been knocked out with a wire brush.

With clean equipment to inspect, the chances of putting faulty valves or connections in service was greatly reduced and saved considerable time and money as a result. Then, too, serviceable equipment was brought into the warehouse, where it was better protected. The original vat had to be taken out of the warehouse when more room was required there.

See These EMSCO PRODUCTS in the CONTINENTAL Bldg. at the EXPOSITION



H-46 Draw Works

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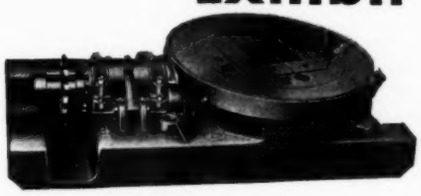
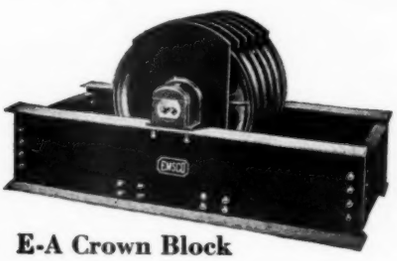
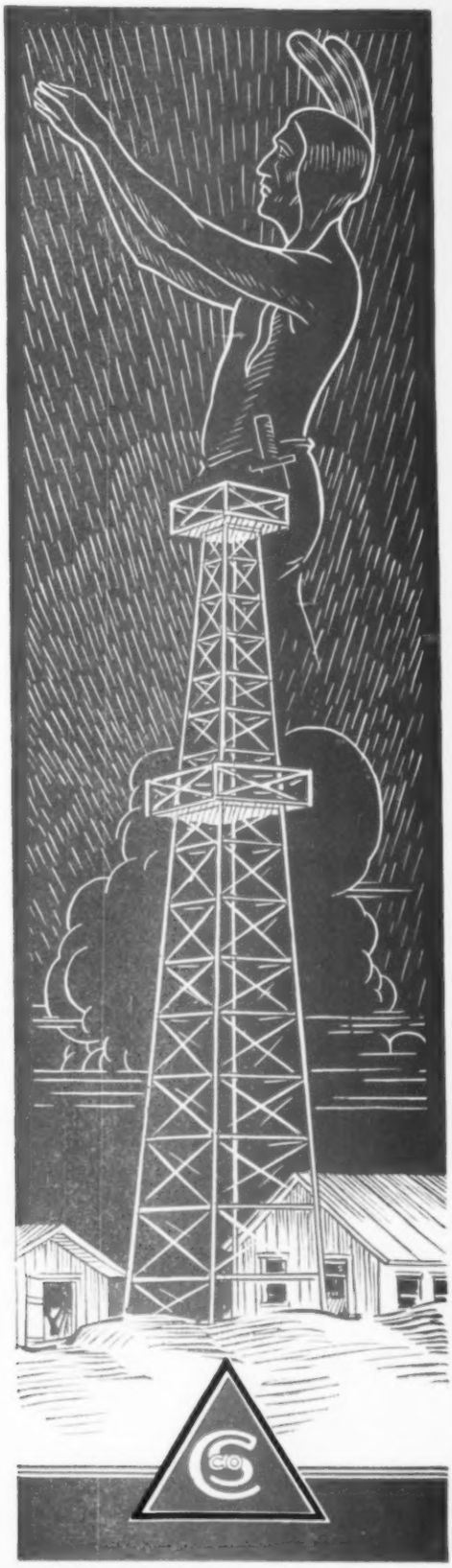


D-A Rotary



E-A Crown Block

B Swivel



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The Importance of Temperature in Measurement *of* Natural Gas

By MAX K. WATSON,
Gas Engineer, Canadian River Gas Co., Amarillo, Texas

THE factor of temperature is not usually given proper emphasis in gas measurement, many concerns assuming that the average yearly gas temperature is approximately sixty degrees. The atmospheric temperature in most sections of the country is approximately sixty degrees, but the question is whether or not that average temperature actually has a balancing effect upon the measurement.

In the first place does the atmospheric temperature necessarily govern the gas temperature? It is true that the atmospheric temperature has a decided effect upon exposed meters and meter runs but does not necessarily entirely govern the gas temperature in all cases. In one instance in the Texas Panhandle, gas was measured at a town border station through an exposed meter run and a recording thermometer installed as a part of the meter. It was found that the recorded temperature reached a minimum of twenty-four degrees in the winter and a maximum of one hundred and seven degrees in the summer with a daily variation of approximately forty degrees. It was at first thought that the thermometer was recording atmospheric temperature and not gas temperature but this was checked with a thermometer placed about ten feet down stream and buried so as to be out of the weather. Furthermore, the actual atmospheric temperature did not reach one hundred degrees during the summer, indicating that the direct sun rays during the afternoon raised the meter run temperature abnormally high.

This meter run was recently laid under ground and the temperature averaged seventy-two degrees or approximately twenty degrees lower than with the exposed meter run construction. This indicates that the construction of the meter run has a decided effect on the gas temperature with the temperature more closely approaching the atmosphere with exposed runs. Regulators, likewise, have an effect upon the gas temperature depending upon the amount of regulation or pressure drop at the regulator ahead of the meter, since a drop in pressure always results in a drop in temperature unless external heat is added in accordance with Boyles law. The point to be brought out from the above is that the atmospheric temperature does not govern the gas temperature in every case and therefore cannot be correctly taken as the average in gas measurements unless it is definitely established that it is the predominating factor.

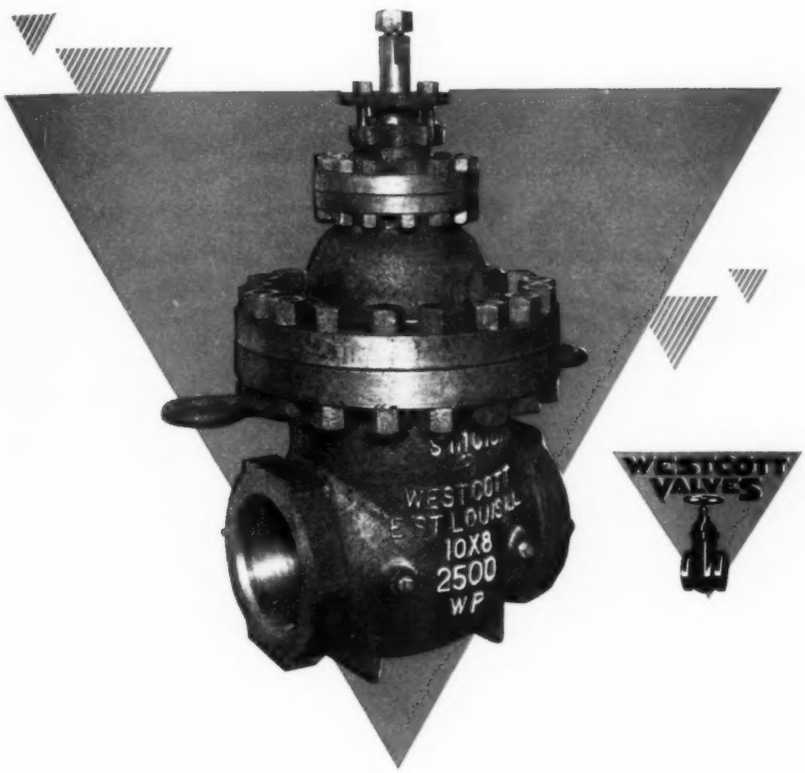
The second question is, assuming that the average gas temperature is sixty degrees, does the total yearly delivery equal the actual amount delivered? All domestic gas loads are heaviest in the winter and at a time when the atmospheric temperature is at the lowest point and therefore at a large plus correction factor if corrected for the actual gas temperature resulting in a large total cubic feet of error based on an average temperature of sixty. On the other hand, the summer load being light, the total cubic feet of error is small when the average temperature is used in preference to the actual. It is evident that the error introduced in each instance cannot balance although the percent of error in both instances may be the same.

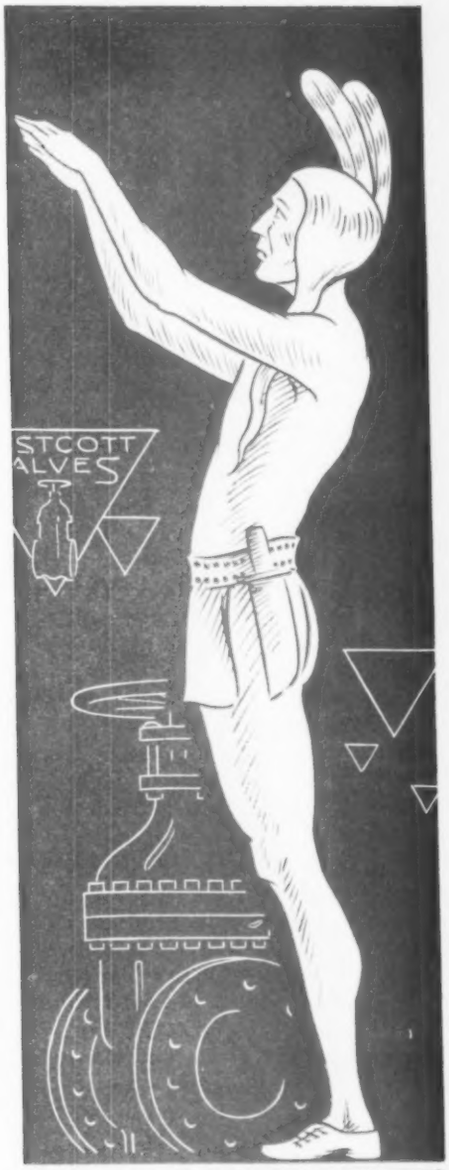
Another point worth mentioning is the effect of temperature on plant and pipe line balance. Domestic meters are usually set out of doors and due to the low velocity, the gas passes through the meters at atmospheric temperature. No adjustment for temperature can be made on the amount billed to domestic consumers resulting in the plant losing gas in proportion to the temperature and at a peak load.

At this same town in the Texas Panhandle mentioned above, a check-up disclosed the fact that gas was actually delivered and measured to the consumers at a temperature of approximately seventeen degrees during certain periods of the day and at approximately thirty degrees for periods of two and three weeks at a time while the gas company was charged for the gas corrected to sixty degrees at the town border station. Under those conditions the gas company operated at a loss of approximately four per cent without considering the usual leakage losses in transmission. The same conditions exist in a pipe line balance if the actual temperature is not used at the meters. This was demonstrated in a check on the gain in the gathering system of a large line out of the Panhandle. The main line master meter, corrected from flowing temperature to a sixty degree base showed a two per cent gain over the field meter totals. The field meters were all exposed to the weather and showed a temperature below freezing altho an average temperature of sixty degrees was assumed in calculating the deliveries which would account for the two per cent gain. During the summer this same system is showing appr imately a two per cent loss for the same reason.

It is indicated therefore, that temperature is as much a factor in metering as is the differential, static, specific gravity, etc., altho to a lesser degree for small variations. However, it can reasonably be stated that the temperature generally has a wider variation than the specific gravity or orifice micrometered dimensions over a long period of time and yet these factors are determined to the highest degree of accuracy at frequent intervals and the differential gauge made to check to the nearest tenth of an inch when the resulting error due to a small variation would be less than that introduced by inaccurate temperature observation over a long period of time. It is strange that the determination of the actual gas temperature should be neglected when it is the cheapest and easiest to determine and the most simple to use in the computations.

SEE THIS AND OTHER WESTCOTT VALVES AT THE EXPOSITION IN THE CONTINENTAL BLDG.





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Big Production from

Shallow Sand *in* Yates Pool Lease

SHALLOW oil production from the Yates A lease of the Continental Oil Company in the Yates Pool, Pecos County, Texas, is unique in the history of the oil industry with respect to both the simple, yet novel, production methods adopted, and the high daily rate of output.

To date, this lease has produced from shallow wells and ditches, over 800,000 barrels of oil at an estimated cost of less than two cents a barrel.

About a year ago, oil shows were encountered in a very shallow horizon, in what is known as the Trinity sand, which, up to this time, was water bearing only, and the source of a domestic water supply in the area. Oil seepages were also observed in the vicinity of the Pecos River, which, investigation revealed, were coming from the Trinity Sand outcrop. These discoveries led to the drilling of some shallow wells by the Continental Oil Company on their Yates A lease about March of this year. To date, about 38 shallow wells, ranging in depths from about 15 feet to 60 feet, have been completed as producers. Also since May of this year five ditches, each about 23 feet deep, have been constructed.

A gasoline-driven caterpillar dragline machine was used in the construction of the ditches. At the wells, the production equipment consists of motor-driven water well jacks. These are operated 24 hours daily. Ordinary rotary type pumps, each of 1000 barrels daily capacity and driven by a 5 H. P. motor, deliver the oil from the ditches to the lease tanks. All the oil produced from the shallow wells and ditches is pumped to lease tank batteries located at convenient points, and allowed to settle, thence it is pumped to storage. Any cut oil is run to an electric dehydrator for treatment.

The present daily combined production, from shallow wells and ditches, is about 4700 barrels. Of this amount, the ditches produce about 1200 barrels, or 25 per cent. Out of the total oil recovered to date on these shallow operations, the ditches have contributed close on 250,000 barrels, or about 30 per cent of the total oil since May of this year, when the first ditches were completed. Roughly, the average total per well up to this writing is 160,000 barrels. Actually some wells have produced more than this amount, since they were not all drilled at the same time.

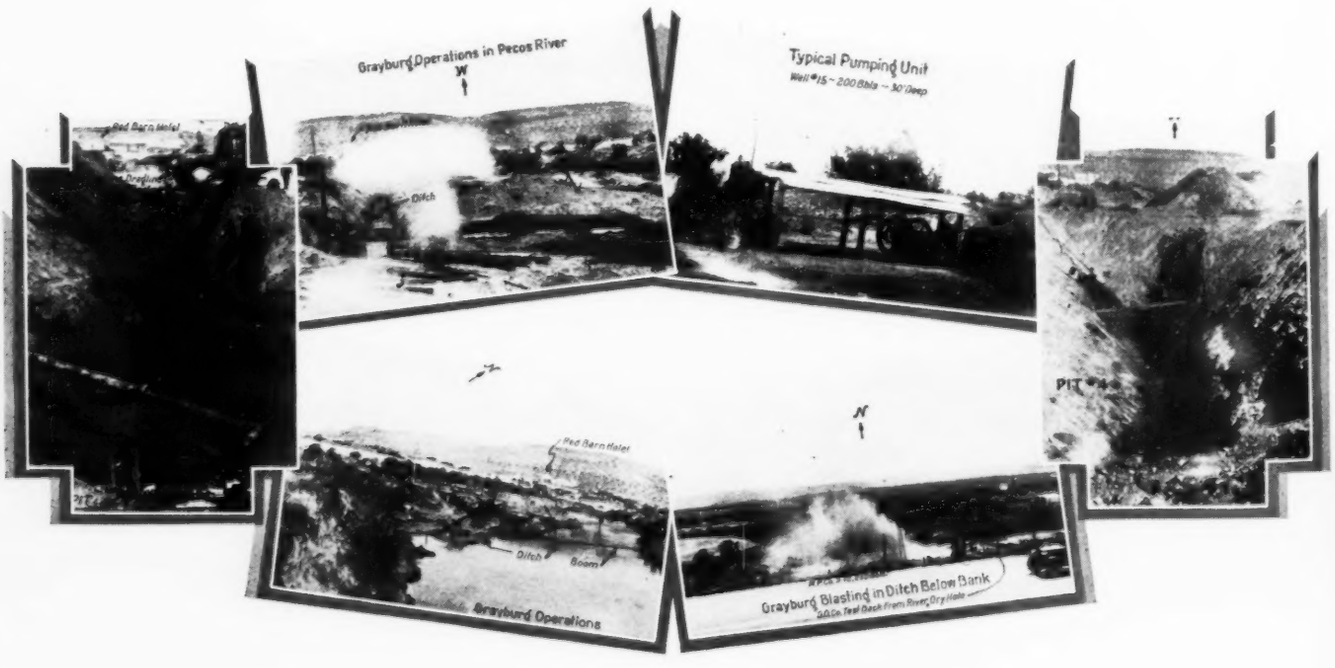
When the final story is written, operations on this lease will probably stand on a record which it will be difficult to duplicate.

The Yates Pool in Pecos County has been the scene of many interesting events. Located in the picturesque section of the Lone Star State, this region was for many years considered as being far from the limits of prospective oil lands, and the ranchers held sway there since the country was settled.

When the first geological surveys were made by the oil companies, only a passing interest was displayed, but later this crystallized and drilling started. The Mid-Kansas Oil & Gas Co. and the Transcontinental Oil Co. jointly discovered the pool, which has developed many exceptional characteristics.

Within the borders of the pool is one well which is claimed to have had the largest rate of output of any well ever drilled in the nation. The field has been under proration of oil runs almost since its discovery, owing to inadequate pipe line facilities.

It is claimed by many that the Yates pool will establish some astounding new figures in the matter of production per acre, and in the meantime it has a potential production of 4,000,000 barrels daily.



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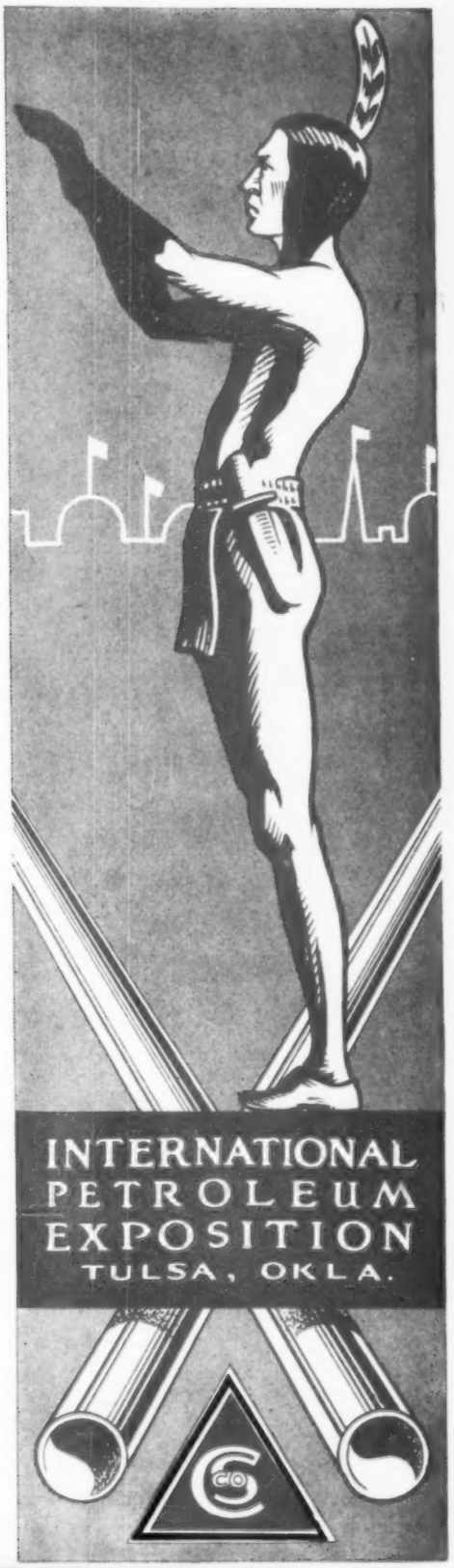

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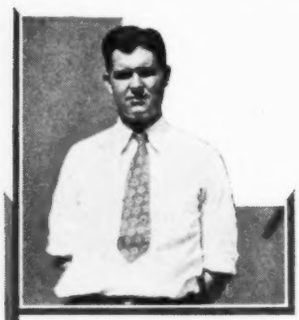
Survey Shows

Most Belt Trouble Caused *by* Clamps*

By HAROLD DECKER
Petroleum Engineer, Tidal Oil Company

THERE has been so much said and written on belts in the past few years that almost anything I should say would not be of particular interest to you. For this reason, I am going to almost eliminate belts entirely and discuss belt clamps. As each of us derive the majority of our knowledge from our own experiences, I am going to discuss belt clamps from the viewpoint of the Tidal Oil Company.

In a recent survey of our belt trouble in the Drumright area, we endeavored to find out what were the causes of our belt failures. This survey covered a period of almost a year. In this time, there were 88 belt jobs and 13 belts replaced. This occurred on 21 wells. The largest amount of our trouble was due to belt clamps. Out of a total of 88 jobs, 48 were clamp jobs. This showed 54½ per cent were clamps breaking. Bolt trouble was 72 per cent of all our clamp trouble. We believe the solution to this problem of clamps is better made and designed clamps and stronger bolts. However, we have found out in our own company that too much emphasis is placed on belts and not enough on pumps, cups, and balls and seats. For the first six months of 1929 our belt trouble for the entire company represented only one per cent of our entire well jobs, while cups represented almost 50 per cent. From this you can easily see that we need to place more stress on our more troublesome equipment.



Top—The author. Left—Bar type belt clamp. Upper row, left to right—Bar type clamp, hinge fastener, Jackson fastener. Lower row, left to right—Alligator belt fastener, clipper fastener, and Crescent type belt fastener.

We believe that in extremely hard wells which give excessive belt trouble, that the solution is either chain drives or endless belts. On our Q. V. Jackson well No. 1, we have an endless belt which has been in service over 168 days without a belt job. In the 178 days previous to this, we had 11 belt jobs on an ordinary belt. We figure the first year we will save $93.00 and each year thereafter $263.00 on this particular well. However, the expense of installation will only warrant its use on hard wells.

Considerable work has been done by the A. P. I. in perfecting and testing belt clamps. The Belt Committee of the A. P. I. estimate that 50 per cent of all belt failures are due to clamps. The weakest link in a chain is usually the place of failure, and in a like manner the weakest point of the belt is the belt clamp. In designing and making belt clamps, almost all belt manufacturers say the ideal belt is the endless belt, and the closer we can approach this, the nearer we will come to better belt service. We probably come nearer this goal in using saddle back clamps than any other type of fasteners, but the saddle back is far from being ideal. Too often we find it breaks the belt at the pinched holes or the saddle gives away.

Belt clamps can be classified generally in the following groups:

1. Plate fastener. Both straight and curved, with fillers and without. A few of the latest bar clamps are corrugated. This type clamp is the oldest and most generally used. It can be easily applied and most of the field men are familiar with its use. However, it is perhaps one of the weakest types of clamp we use, as the belt is bent at the right angles in tightening the clamps.

2. Saddle back. Where a piece or pieces of belt are placed over the butt ends of the belt and fastened to the belt with bolts, this comes nearer reaching our idea of a perfect belt. The greatest problem with this clamp is getting the field men familiar with its application.

3. Hinged plate. This fastener is similar to the saddle back, except that the two ends of the belt are held together by a hinge and bolt.

*Presented before the Drumright, Oklahoma, chapter of the A. P. I. division of development and production engineering.

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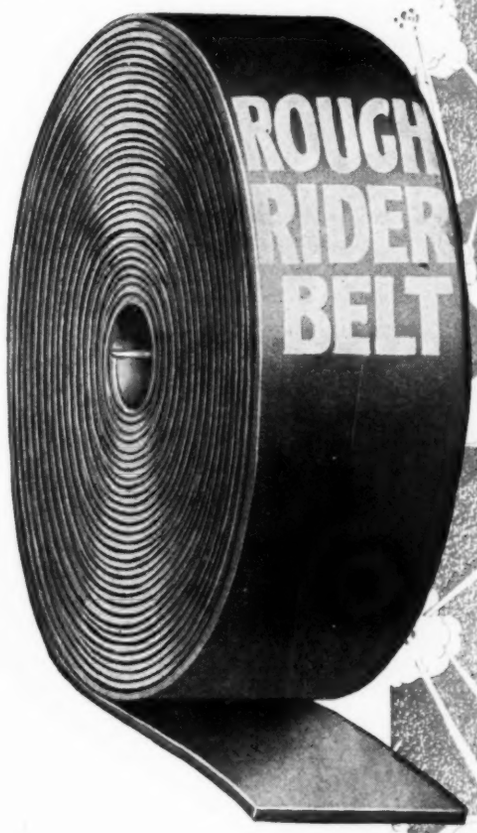

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SPURIOUS PARTS RESPONSIBLE *for* Much Loss *of* Time *and* Money

THE use of spurious parts in repairing oil field equipment has, since time immemorial, been the source of annoyance and trouble to manufacturers of the equipment. And, according to manufacturers, this practice has been uneconomical and unsatisfactory for the most part.

Various steps have been made by several manufacturers in combatting the evil, but few, aside from costly educational plans, have brought desired results. It has proven difficult sometimes to overcome the high and elastic discounts offered by some of the firms making spurious parts. In some instances discounts ranged upward as high as 50 per cent. As a whole the discount range was rather surprising, some companies getting 25 per cent off and others much higher.

It was a common occurrence that spurious parts went out of service within a few weeks after their installation. This, of course, applied to small moving parts. On heavy machinery the service life was greater, but nowhere near the average service life of faultless genuine parts.

Manufacturers of small equipment were troubled the greatest from this source, for obvious reasons. For the most part, those manufacturers were primarily interested in selling new installations. Their service, therefore, was not so much built for profit as it was to create confidence and good will. Consequently, when their machines failed to live up to the purchaser's expectations the manufacturers took the brunt of the blow and were forced to make costly inspections that in many instances showed the fault to be the use of spurious parts.

It also has been difficult in many instances to convince field men that only the best grade of materials go into the making of genuine parts. Spurious parts too often are made from inferior material, consequently the ability to offer the more attractive price and discount condition.

A manufacturer of ignition equipment, for some time annoyed with complaints originating from the use of spurious parts, decided to locate a warehouse and shop at a central point and is finding it a successful means of combatting the trouble. Instead of fixing a flat rate charge for repairing the machines, a maximum service charge was used. It ranges from zero to $6.00.

Too frequently the flat rate charge more than covered the cost of repairing the machine. For the most part the machines sent in required either a cleaning and adjustment or the installation of a couple or three parts. A feature of this work is that it is done by factory men, skilled in the building and adjusting of the machines. The service is made more attractive to purchasers because the coils in the machines are replaced free of charge. The manufacturing company confines itself strictly to repairing its own machines.

As the service is more widely used, the less trouble owners of the machines are having from delays and shutdowns. Backing up this service are the representatives who tour the fields, making suggestions for the care and operation of the equipment.

For companies using scores of the machines an exchange service has been started. As the machines go out of service they are brought in from the lease and stored at the warehouse. When the number is sufficient they are sent by rail to the manufacturer's shop. At the same time a letter or wire is sent, advising the factory branch of the number and type of machine shipped.

Upon receipt of this information the factory branch employees ship by rail an equal number of the same type of machines to the producer. These are taken from stock. When the crippled machines are received and repaired they are put in stock to replace those machines shipped. The purchaser is then billed for the actual cost of repairing the machines shipped in.

To some extent this system of exchange was frowned upon by the owners of machines. In the first place, the identity of the machines they purchased was lost and the transfer also entailed considerable book work. However, it apparently is gaining in popularity and several of the major companies have taken advantage of it.

Manufacturers of various makes of equipment for oil field use have made surveys which showed that equipment repaired with genuine parts will operate at least from six to twelve months, depending on the care given the machine. The same type of equipment repaired with spurious parts has an average service of only three months, the survey showed. Exceptional cases discovered in the survey were where companies were getting an average of nine months service with their equipment.

It was found that companies devoting time to the training of employees in caring for machines under their charge were getting much better service. Many of the companies hold monthly meetings for farm bosses and pumpers. At these meetings the service men explain the care required to obtain the best results from the machines. At the same time they are prepared to answer the questions of pumpers and other field men regarding problems peculiar to their machines.

One of the most common sources of trouble in ignition equipment comes from the coils. This, to a great extent, can be overcome by more closely watching the spark gap. Cleaning out and pulling rods and tubing put an increased strain on the coils by burning the points on the spark plugs as a result of high compression and increased engine speed. As the spark gap widens, the strain on the coils is increased. For smoother operation engineers recommend the spark gap should be between .018 to .025 of an inch.

And so on down the line in various makes of standard equipment are found sources of trouble which can be overcome to a great extent with proper operating care. However, unless genuine parts are used for replacements, excellent care cannot compensate for parts built with inferior material what it would do for parts made with the care, skill and first-class material used by the manufacturers of the original equipment.

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June 6, 1929

The Continental Supply Company,
Fort Worth, Texas.

Gentlemen:

Just three months ago we started up our first Diesel engine in West Texas and it occurs to me that you would like to know what we think of it.

Our first installation was a 40 horse power Fairbanks & Morse Diesel Oil Field Engine, it was set at our Settles "B" No. 1 which is located in the Dora Roberts Pool, Howard County, Texas. This well is producing from the pay zone found at 2900 feet, equipped with 3 inch tubing, 3/4" and 7/8" sucker rods, the oil is heavy, being of 27 gravity. This engine has been in continuous operation since its installation and has certainly performed to our satisfaction.

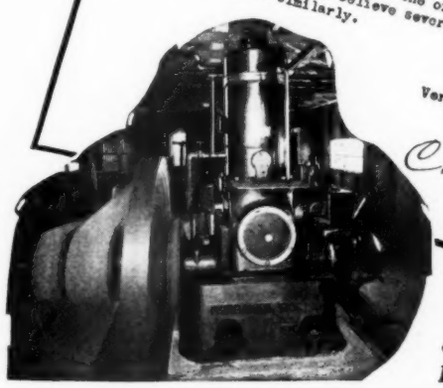
The fuel situation in West Texas is quite a problem and the Diesel engine entirely solves it, cost of operation is exceptionally low and performance very high. This engine consumes 40 gallons of crude oil per day and approximately 2½ quarts of oil, bringing the total cost to 93¢ per day - an average of $28.29 per month over a period of one year. That performance is unusually high is shown in the fact that our records disclose no shut down time charged to the engine during the three months it has been running.

The results of the first installation have been so satisfactory that we have added several more of these engines and expect to so equip our other wells as quickly as completed.

This installation has been viewed by a large number of production men who are well known in the oil fraternity and each of them seemed completely sold, I believe several are going ahead with plans to equip their wells similarly.

Very truly yours,

C. L. Sutton



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CONTINENTAL

See it at the Continental Exhibit at the Exposition

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Analysis *of* Olefin *and* Aromatic Hydrocarbons

By J. C. MORRELL and I. M. LEVINE,
Research Laboratories, Universal Oil Products Company, Chicago, Ill.

Presented at Minneapolis meeting of American Chemical Society.

IN a concurrent article by Faragher, Morrell and Levine, a method was given for the determination of olefin and aromatic hydrocarbons which involved the determination of the sum of the concentrations of both of these types of hydrocarbons, the removal of the olefins by means of sulphur monochloride and distillation from the reaction products and finally the determination of the aromatic hydrocarbons in the olefin-free oil. This method is accurate and best adapted to research. For routine work, where the accuracy required is about two per cent or more, a method has been evolved which involves the use of sulphuric acid only.

The concentration of the olefins and aromatic hydrocarbons together is determined in the same way as it is done in the more exact method. The olefin content is then calculated by means of the formula:

$$U = \frac{4}{3} \frac{PV_1V_D}{V_2W_D}$$

where
- U is the percentage olefin content.
- P is the weight of the distillation residue.
- V_1 is the volume of oil remaining after treatment with 91 per cent sulphuric acid.
- V_D is the volume of the oil in the distillate.
- W_D is the weight of the oil in the distillate.
- V_2 is the volume of the oil distillate.

The results obtained by use of this equation are given in Table I.

TABLE No. I

Oil	A÷U	P	V_1	V_2	$\frac{W_D}{V_D}$	U by S_2Cl_2 Method	U Calc.
California	35.5	12.1	82.5	81.0	.760	21.4	21.6
Panhandle	43.3	18.5	80.4	79.1	.727	32.8	34.4
Seminole	38.1	14.1	82.6	81.5	.725	29.1	26.3
Pennsylvania	35.4	13.4	84.1	82.9	7.28	25.5	24.8
Venezuela	38.4	11.7	79.9	78.0	.753	20.6	21.2
Pecos	44.1	17.6	80.8	79.1	.738	32.8	32.4
Panuco	42.9	15.3	79.0	78.0	.750	27.3	27.6
Smackover	45.5	17.2	79.4	77.9	.725	31.2	32.3

Titration of Olefins With Bromine

A rapid and fairly accurate method has been developed whereby olefins are determined by titration with a solution of bromine in carbon tetrachloride. The objections raised against the use of the bromine number, namely, that the paraffins react and that all the olefins do not, are partially overcome by the titration of a standard solution containing a known concentration of a known olefin or mixture of olefins under the same physical conditions. The titration is carried out as follows: The oil (2 cc.) is diluted with 8 cc. of an olefin-free naphtha and an approximately 5 per cent solution of bromine in carbon tetrachloride is added from a burrette, five drops at a time, stirring after each addition. The end-point of the titration is that point where a definite reddish orange color persists for thirty seconds. This end-point is one which each operator has to fix in his own mind. The titration should be carried out in diffused light; direct sunlight causes the production of hydrogen bromide, which obscures the end-point because the solution becomes turbid.

The olefin in the standard solution may be a single hydrocarbon in which case a knowledge of the average molecular weight of the olefins present in the solution would be necessary for the calculation of its olefin content. However, the standard may consist of the same type of mixture of hydrocarbons as those in the oil to be analyzed. The olefin content is then calculated by use of the formula:

$$U = \frac{T_1}{T_2} S$$

where U is the olefin content in the solution.
S is the olefin content in the standard.
T_1 is the titer of the solution.
T_2 is the titer of the standard.

If the standard contains but one olefin, the formula to be used is:

$$U = \frac{T_1M_2D_1}{T_2M_1D_2} S$$

where M_1 is the molecular weight of the olefin in the solution;
M_2 is the molecular weight of the olefin in the standard;
D_1 is the density of the olefin in the solution;
D_2 is the density of the olefin in the standard.

Various volumes of a 12.04 per cent octylene solution were titrated. The results shown in Table II that the titer is directly proportional to the volume of octylene solution titrated.

TABLE No. II

cc. Solution	Titer	Vol. Br_2 Solution / Vol. Octylene Solution
10	5.08	0.51
5	2.6	0.52
4	2.2	0.55
3	1.5	0.50
2	0.98	0.49

A mixture of limonene and octylene were titrated using octylene as the standard. The olefin content of such a mixture is given by the formula:

$$U = E \div 1.94L$$

where E is the percentage of octylene in the mixture
L is the percentage of limonene in the mixture.

The results are shown in Table III.

TABLE No. III

Mixture		cc. Br_2 Solution	
Per cent Octylene	Per cent Limonene	Observed	Calculated
4.56	4.39	12.72	13.08
10.18	3.67	16.47	17.30
17.60	5.69	28.41	28.63

(Turn to Page 94, please)

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Determination of Olefins and Terpenes

Diolefins are more reactive than are mono-olefin and polymerize more easily. It is by means of selective polymerization that diolefins or terpenes may be determined in the presence of the simple olefins. The reagents tried were sodium and the following acids, nitric, phosphoric, mono, di and trichloroacetic, and sulphuric, only the last of which was found to be effective.

From a study of a mixture of octylene and limonene, the best results consisted of the polymerization of 93 per cent of limonene and the concurrent polymerization of 11.5 per cent of octylene. The method developed requires two steps:

1. The "concentration" of all olefin bonds are determined by titration with bromine as described in B.
2. The diolefins are preferentially polymerized. The oil (100 cc.) is shaken with 30 cc. of 75 per cent sulphuric acid for thirty minutes, allowed to stand for one hour and acid sludge withdrawn during one more hour. The oil is then distilled to a temperature five degrees above the end point of the oil. The distillate is again titrated with bromine.

The calculations are made by the use of the equation:

$$L = .56M - .63D$$

and $$E = M - 1.94L$$

where M is the titer of the mixture
D is the titer of the distillate
E and L have the same significance as in B.

Mixtures of octylene and limonene were analyzed and the results are shown in Table IV.

TABLE No. IV

Mixture				Found	
% Octylene	% Limonene	M	D	% Octylene	% Limonene
4.56	4.39	12.72	4.61	4.54	4.22
10.18	3.67	16.76	9.63	10.3	3.33
17.6	5.69	28.41	16.07	17.2	5.78

Pinene, terpineol and linalool behave like limonene. The two terpene alcohols yield hydrocarbon polymers as do the terpenes themselves, similarly to the behavior of the tertiary amyl alcohol which was found to give a very good yield of decylene.

Some of the chemistry of the reactions of olefins is discussed in the paper.

Factors Influencing Motor Oil Performance

By C. S. ROBINSON* and W. W. SCHEUMANN**

A LABORATORY and road service study of motor oils from the three chief United States sources indicates that motor oils from Pennsylvania and Mid-Continent sources are superior to oils from South Texas sources in low rate of exchange of viscosity with temperature, low volatility, and engine life, while South Texas oils are superior in carbon formation.

Among the factors influencing motor oil performance, there are four that appear to be outstanding. These are as follows:

(1) Change of Viscosity with temperature.
(2 Volatility.
(3) Rate of Carbon Formation.
(4) Rate of decrease of viscosity with use.

Viscosity—Temperature Effect.—An unfortunate feature in the modern automobile engine, from the lubrication standpoint, is the requirement that a single oil shall lubricate all parts of the engine simultaneously. When it is realized that the temperature of the oil may vary from below zero (32°F) when the engine has been standing idle in winter, to as high as 500°C. (932°F) or more, as has been shown by aluminum alloy pistons melting while the engine was running, the need for an oil which has satisfactory viscosity over such a rtemendous temperature range is readily apparent.

Volatility.—The temperature of the oil in the grooves of a hot piston may conceivably approach the temperature of the piston itself. This hot oil, working its way up to the top of the piston and onto the cylinder walls, has a vapor pressure depending on its temperature. This vapor pressure tends to cause the oil to vaporize into the combustion space, and the vapor, either burned or unburned, passes out of the cylinder with the exhaust gases. From the standpoint of both economy in the use of oil and the avoidance of smoke nuisance, a satisfactory motor oil should have low volatility.

Carbon Formation.—The thermal decomposition of the oil in the combustion space of an engine forms among other products a carbonaceous residue. This residue collects on the walls of the combustion space and on the top and bottom of the piston head, insulating these surfaces against the flow of heat. This, in turn, causes excessive combustion temperature with the formation of unpleasant knocking due to detonation. The time required for and the cost of removing this carbon is an economic feature of real importance.

Loss of Viscosity.—Motor oils decrease in viscosity while in use in the engine. If this could be largely avoided, an oil could be allowed to remain in the engine almost indefinitely, providing the sediment be removed by filtration. This is also an economic feature in engine operation.

The writers have obtained road and laboratory data on these factors which are presented below.

Viscosity—Temperature Effect

Numerous investigators have shown that the relative viscosity of an oil, when plotted on logarithmic paper against the temperature, gives approximately a straight line. The slope of this line is, therefore, a measure of the change of viscosity with respect to the temperature. The following table shows the data obtained on typical motor oils prepared from the three most important sources, namely, Pennsylvania paraffin base crude oil, Mid-Continent paraffin base crude oil, and South Texas naphthenic base crude oil.

TABLE I

No. of Sample	Source	Absolute Viscosity C. G. S. Units 37.8° (100°F)	98.8° (210°F)	Slope of Vis. Temp. Curve Log Vis. vs. Log Temp.
1	Penna.	0.219	0.0436	—2.04
2	Penna.	0.275	0.0502	—2.14
3	Penna.	0.347	0.0562	—2.30
4	Penna.	0.457	0.646	—2.46
5	Mid-Cont.	0.229	0.0372	—2.30
6	Mid-Cont.	0.289	0.0447	—2.40
7	Mid-Cont.	0.407	0.0537	—2.48
8	Mid-Cont.	0.576	0.0758	—2.72
9	South Texas	0.245	0.0398	—2.35
10	South Texas	0.407	0.0525	—2.56
11	South Texas	0.646	0.0513	—2.90
12	South Texas	0.832	0.0892	—3.30

(Turn to Page 96, please)

*Dept. of Chem. Eng., Mass. Inst. of Technology.
**Cities Service Refining Co., East Braintree, Mass.
Presented at Minneapolis meeting of American Chemical Society.

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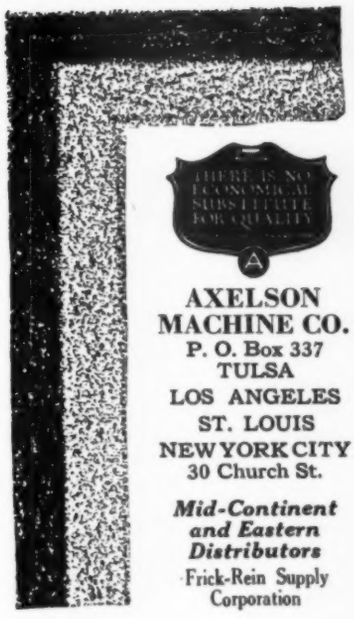

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These data show that for oils of the same viscosity, at any given temperature, the Pennsylvania oils have the least slope and the South Texas oils the greatest. To show this effect, take oils 2, 7 and 10 which have approximately the same viscosity at 98.8°C (210°F), and extrapolate the viscosities to 0°C (32°F) and 300°C (572°F), which is shown in table No. II.

TABLE II

Oil No.	Source	Vis. @ 98.8°C	Slope	Viscosity calculated at 0°C	Viscosity calculated at 300°C
2	Penna.	0.0502	—2.14	3.47	0.0059
7	Mid-Cont.	0.0537	—2.48	5.36	0.0042
10	South Texas	0.0525	—2.56	6.16	0.0025

*Volatility**

In order to determine the relative volatility of commercial oils, samples of medium motor oils were purchased on the open market and distilled under 2 mm. absolute pressure according to the method given by Peterkin and Ferris. (Ind. and Eng. Chem. Vol. 17, 12. pp. 1248 [1925]).

As a relative test of volatility the per cent distilled over at 98.8°C (210°F) at this pressure was noted and is given in table No. III.

TABLE III

No. of Sample	Source	Per Cent Loss at 98.8°C (210°F)
13	Penna.	2.0%
14	Mid-Cont.	11.0%
15	Penna.	14.7%
16	Mid-Cont.	15.3%
17	Mid-Cont.	16.2%
18	Mid-Cont.	17.4%
19	South Texas	23.4%
20	South Texas	23.8%
21	South Texas	41.8%

*L. S. Coonley M. I. T. Thesis.

Carbon Formation

It has been shown by Livingstone, Marley and Gruse (Ind. and Eng. Chem. Vol. 18, 5 pp. 502 [1926]) that the carbon formation in a motor is approximately proportioned to the amount of bright stock present in the oil. In order to obtain an equivalent relation, based on the vacuum distillation given above, the per cent of residue left at 143.5° (290°F), was noted since evidences of cracking were obtained in the oils at that temperature.

Table IV gives this per cent residue for the same medium commercial oils given in table III.

TABLE IV

No. of Sample	Source	Per Cent Residue at 143.5° (290°F)
21	South Texas	3.5%
20	South Texas	12.0%
19	South Texas	14.0%
18	Mid-Cont.	17.0%
14	Mid-Cont.	20.0%
17	Mid-Cont.	23.5%
13	Penna.	25.3%
16	Mid-Cont.	27.0%
15	Penna.	32.0%

Decrease of Viscosity

Service tests were made on four trucks as follows:

TABLE V

No. of Truck	Weight	Oil Filter	Crankcase Ventilator
A	11060 lbs.	HW Oil Filter	none
B	11080 lbs.	HW Oil Filter	none
C	11110 lbs.	HW Oil Filter	none
D	14520 lbs.	HW Oil Filter	none

Oils from each of the three sources were used in each truck and the trucks were then operated for 1000 miles, the viscosity and per cent dilution being determined at 200-mile intervals.

The data are given in table VI.

TABLE VI

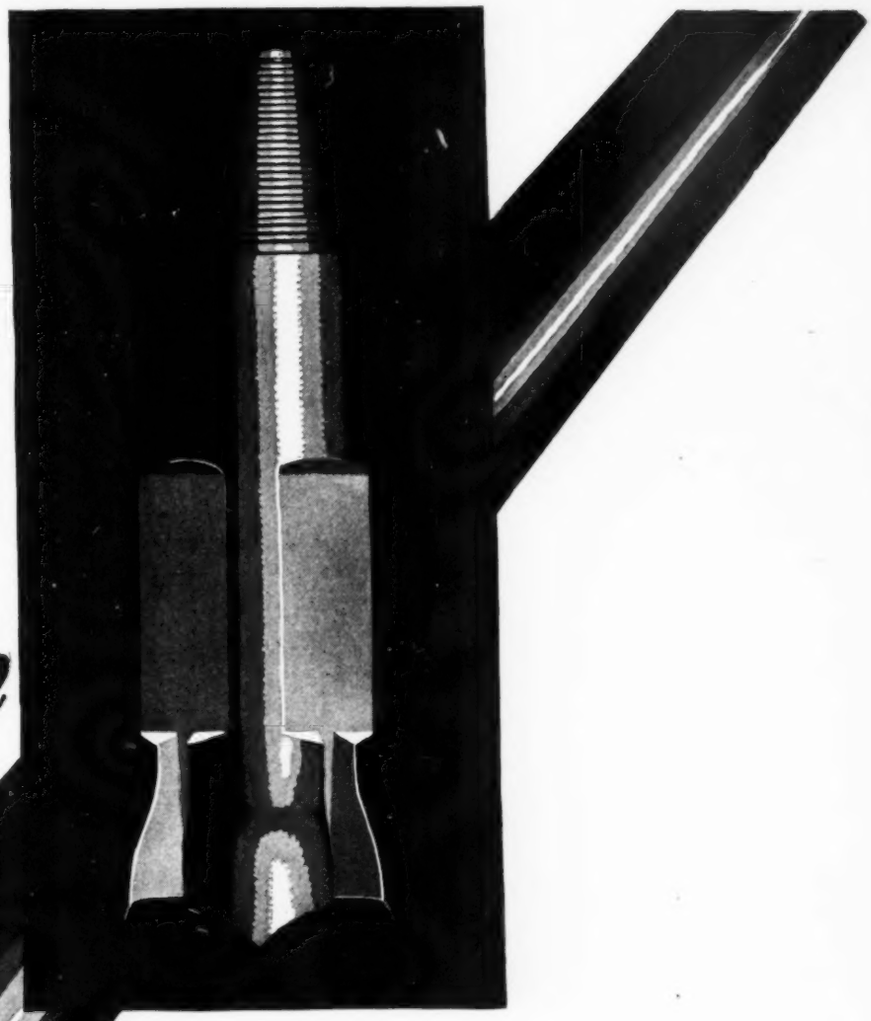
No. of Truck	Source of Oil	Vis. of Oil at Start Saybolt Sec. at 100°F	200 Miles Visc.	200 Miles % Dilution	400 Miles Visc.	400 Miles % Dilution	600 Miles Visc.	600 Miles % Dilution	800 Miles Visc.	800 Miles % Dilution	1000 Miles Visc.	1000 Miles % Dilution
A	Penna.	480	209	12.5	199	14.5	198	15.5	180	16.5	190	14.0
A	Mid-Cont.	590	307	11.0	287	12.0	280	12.0	282	12.5	259	13.0
A	South Texas	500	169	12.0	172	13.5	151	16.0	139	19.0	140	18.5
B	Penna.	480	241	9.5	231	11.5	211	13.0	217	14.5	232	11.5
B	Mid-Cont.	590	230	10.0	202	14.0	234	12.0	202	13.0	180	16.0
B	South Texas	500	228	8.5	189	13.0	195	13.5	165	15.5	192	15.0
C	Penna.	480	210	13.0	231	14.0	178	15.0	194	16.0	159	18.0
C	Mid-Cont.	590	305	10.5	275	11.5	237	15.0	198	16.5	266	14.5
C	South Texas	500	210	12.5	180	16.5	198	14.0	186	17.5	198	17.0
D	Penna.	480	243	9.0	289	8.0	295	7.5	238	11.0	302	9.0
D	Mid-Cont.	590	246	10.0	314	7.0	225	12.5	208	13.5	182	17.0
D	South Texas	500	303	9.0	234	13.0	270	10.0	131	25.0	Stopped	

Table VI indicated but little difference in the oils from the three sources.

The tests on the trucks were then continued, make-up oil being added as needed, until the viscosity dropped to the danger point, when the tests were stopped. Table VII shows the total mileage for each truck during the test.

TABLE VII

No. of Truck	Source of Oil	Total Miles	Per Cent Make-Up Added
A	Penna.	2600	82%
A	Mid-Cont.	2600	45%
A	South Texas	1000	25%
B	Penna.	2400	70%
B	Mid-Cont.	2800	65%
B	South Texas	1000	30%
C	Penna.	1400	30%
C	Mid-Cont.	2200	55%
C	South Texas	1800	110%
D	Penna.	1600	35%
D	Mid-Cont.	2600	60%
D	South Texas	800	10%



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CHEMISTS DISCUSS TUBE CORROSION *from* Burning Acid Sludge*

By F. R. LANG *and* LOWREY LOVE

THE purpose of this paper is to discuss the corrosion of boiler and preheater tubes occasioned by the burning for fuel purposes of acid sludge produced from the sulfuric acid treatment of lubricating oil. This acid sludge is sometimes burned as such and sometimes in a blend with fuel oil. Unless proper precautions are taken, this corrosion becomes rather excessive. Some precautionary measures to allay or eliminate this corrosion will be discussed.

It has become a practice in refineries to utilize acid sludges by burning them as fuel in various plant units. Either burning the heavy semi-solid sludges, from the treatment of lubricating stocks, without admixture of lighter fuel oils, in burners of the rotary type, or mixing the sludge with a light fuel oil and firing with the regular type oil burner is practiced. When this type of fuel is used continuously, serious corrosion to the outside of the boiler tubes results.

We have examined and analyzed various types of this sulfur corrosion from the outside of tubes, tube sheets, baffle plates, etc. By chemical analysis we found that the average composition of such corroded material would be about as follows:

Constituent	*Approximate Proportion*
Sodium (Na)	Small amount
Iron (Fe)	Very large amount
Calcium (Ca)	Small amount
Sulfates (SO_4)	Large amount
Sulfites (SO_3)	Very small amount

Two different materials are usually found in samples of this corroded material, one being ordinary iron rust and the other a light gray deposit. By analysis, the latter material was found to be anhydrous ferrous sulfate, in varying amounts up to 93 per cent of the sample. Samples of practically pure hydrated ferrous sulfate have been found on tube sheets when the furnace is steamed during shutdown periods.

The above analysis would indicate that the corrosion was due to the SO_2 and SO_3 fumes from the burning fuels. These gases, however, will not likely corrode the metal of the boiler tubes unless there is condensed moisture present. The normal operating temperature is much too high to allow moisture to condense, accordingly the maximum corrosion must occur in the short periods when the fuel is burning and forming SO_2 and SO_3 and the boiler tubes are cold and have condensed moisture on them.

Boilers are shut down periodically and the tubes are flushed out with cold water. During this flushing out process the tubes become very wet on the outside, due to moisture condensing on the cold tubes. Steam is sometimes injected into the combustion space during shutdown to avoid hazard from accumulation of gas in case of burner leaks. This also allows moisture to condense on the exposed metal.

When the fires are started again under the damp or wet tubes, the SO_2 and SO_3 fumes from the burning fuel form with the moisture sulfurous and sulfuric acid which will attack the iron readily. Even if the tubes were perfectly dry when the fires were started, the steam that is injected with the fuel and the water vapor from the burning hydrocarbons and acid in the sludge would condense on the cold pipes and allow the formation of acid in contact with the metal.

Large "mushroom" deposits of corroded material have been found on preheater baffle plates where the acid solution is formed and drops from above as the fires are started. This acid solution works its way to the lower tubes next to the tube sheet and at this point a large amount of corrosion takes place. Of course, if the boilers are down for any extended length of time, the damp tubes will form a layer of hydrated iron oxide which will react with the SO_2 and SO_3 fumes to form iron sulfate and sulfite. As stated before, there is a varying but usually small amount of iron oxide in the sample of corroded matter. This would be formed during the shutdown period. With condensed moisture the iron salts would hydrolize, making an acid solution. The acid attacking the pipe would leave the iron in the form of the hydroxide. Part of this would react with the SO_2 and SO_3 when the fires were started again and part would be dehydrated to the oxide.

Since the corrosion occurs chiefly only while the units are being put back into service after a shutdown, heating up the tubes immediately after flushing with a fuel that does not contain a large amount of sulfur would eliminate the possibility of acid forming on the tubes during this period. As soon as the tubes are dry and too hot for moisture to condense on them, the regular sludge mixture could be "cut in." If, along with the above, the injection of steam is avoided and the shutdown period made as short as possible, the corrosion from burning fuels with high sulfur content could be practically eliminated.

The method of "firing-in" with straight fuel oil and introducing the acid sludge only after heating up the boilers has been found to be successful in actual boiler plant operation and the corrosion, which is excessive when "firing-in" with the acid sludge blend, has been practically eliminated.

*Presented before the Minneapolis meeting of the American Chemical Society.

THE Colona Manufacturing Company of Pittsburgh, Pa., has distributed folders giving the details of its pipe thread protectors which are coming into more general use in the petroleum industry.

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Determination *of* Olefin *and* Aromatic Hydrocarbons

By W. F. FARAGHER, J. C. MORRELL and I. M. LEVINE

Research Laboratories
UNIVERSAL OIL PRODUCTS COMPANY
Chicago, Ill.

Presented at Minneapolis meeting of American Chemical Society.

THE method of the determination of olefin and aromatic hydrocarbons in gasoline previously developed by the writers was applied to fractions of petroleum boiling above the gasoline range. In the case of kerosene or furnace oil the procedure may be employed with very little change with the exceptions that the distillation to separate the olefin-sulphur monochloride reaction products from the unchanged oil is carried out in vacuo entirely, and that the aromatic hydrocarbons are determined by sulphonation instead of nitration. The nitration mixture cannot be used in some oils for since the products of nitration are solid the volume of the unchanged oil cannot be determined accurately because some is absorbed by the solid material and because the acid-oil interface is very uneven. Furthermore the nitratable hydrocarbons are not wholly removed by a single nitration.

For some oils the determination of the sum of the olefin and aromatic hydrocarbons is simplified. This value is obtained by single sulphonation with 98 per cent sulphuric acid. This procedure is possible because the olefins in these oils are aromatic olefins and like styrene are removed, probably, as sulphonated compounds. Sulphonation of the oil itself and of that from which the olefins have been removed result in oils which have practically the same index of refraction. In the case of gasoline and some kerosenes this is not true. The olefin-free material after sulphonation of these oils have smaller indices of refraction than those of the untreated oil due to the solution of the polymerization products of the olefins in the latter.

For gasoline the variation in the period of contact with the sulphur monochloride between the limits of 6 to 16 hours has practically no effect on the results. This is not true in the case of higher boiling fractions of petroleum. For some oils the olefins all react in a contact period of six hours. In a shorter period all the olefins do not react; in a longer one, the aromatic hydrocarbons enter into reaction. Thus the contact time is very important. The fact that some kerosenes have been found for which the critical period is as high as two days, however, presents a difficulty, for this period would have to be determined in each case. The difficulty was met by the application of a double analysis.

This is based upon the finding that although the aromatic hydrocarbons react when the contact period is too long, an olefin-free oil containing aromatic hydrocarbons does not react with fresh sulphur monochloride within two days. This signifies that the olefin-sulphur monochloride reaction products play an important part in the activity of the aromatic hydrocarbons toward sulphur monochloride, for without them no reaction occurs. This was actually proved by experiment. Thus if an oil is allowed to react with sulphur monochloride, distilled, and the process repeated, two types of results may obtain. The sulphonation value of the second distillate may be either equal to or smaller than the first. If equal, no olefins were present in the first distillate; if smaller, the contact time was too small for all the olefins to have reacted. The contact periods chosen were 6 hours and 2 days, since these represent the smallest and largest critical periods, respectively.

The procedure for the determination of olefin and aromatic hydrocarbons and kerosene follows:

(1) The sum of the olefins and aromatic hydrocarbons is determined by either the same procedure used for gasoline or by sulphonation. The second method is faster and requires less oil. It has been found effective for those oils boiling between 260° and 320°. The oil (20 cc.) is shaken with 60 cc. of 98 per cent sulphuric acid in a nitration tube for fifteen minutes, allowed to stand for one hour, the acid withdrawn, allowed to stand one more hour and the loss observed. The sum of the olefins and aromatic hydrocarbons is 0.6 per cent less than the observed loss.

(2) The olefins are removed by means of sulphur monochloride. To 100 cc. of the oil 15 cc. of sulphur monochloride is added and the mixture is allowed to stand for six hours. It is then washed with water and alkali to remove the unchanged reagent, dried, and distilled at a pressure low enough to permit all the unchanged oil to distill over below 160°, the decomposition point of the olefin sulphur monochloride product. For oils with an end point above 320° the pressure must be lower than 0.1 mm. The distillate is treated in a similar manner with the exception that the sulphur monochloride was allowed to remain in contact with the oil for two days. The distillate from the second treatment is analyzed for aromatic hydrocarbons by sulphonation. As in the determination for the sum of the olefin and aromatic hydrocarbon, the correction of 0.6 per cent has to be applied. The same formula used in the analysis of gasolines is applied here.

The results of some of the oil analyzed are tabulated below:

No.	Source	Boiling Range	Critical Contact Period	Per cent Aromatic Hydrocarbons	Per cent Olefins
1	Pennsylvania		2 days	15.3	6.5
2	Midcontinent (cracked)	210-258	6 hrs. 16 hrs.	21.3	17.0
3	Midcontinent	-291	6 hrs.	16.0	1.2
4	California	192-330	1-2 days	8.1	5.0
5	Gulf Coast	257-314	9-16 hrs.	20.2	6.6

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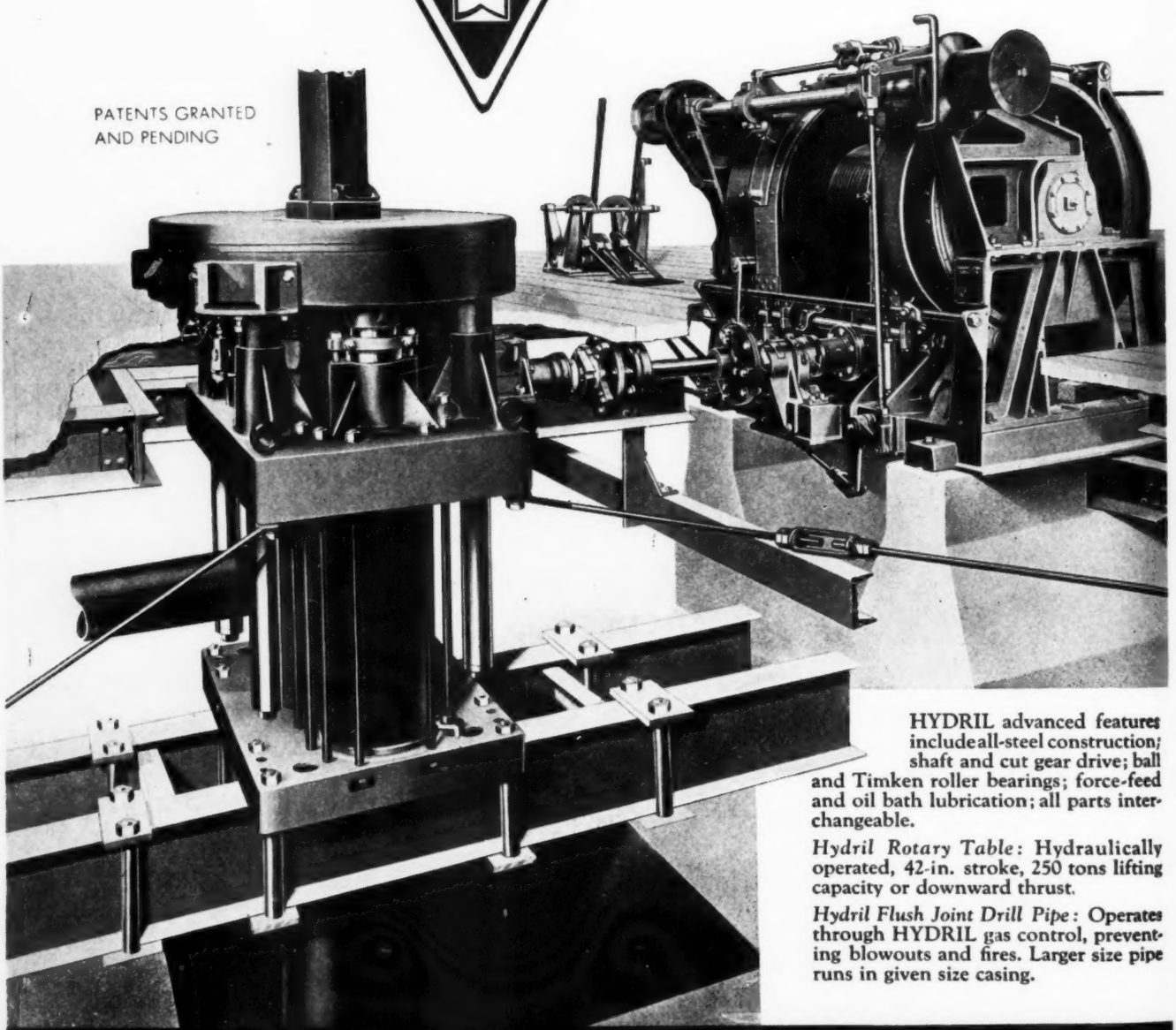

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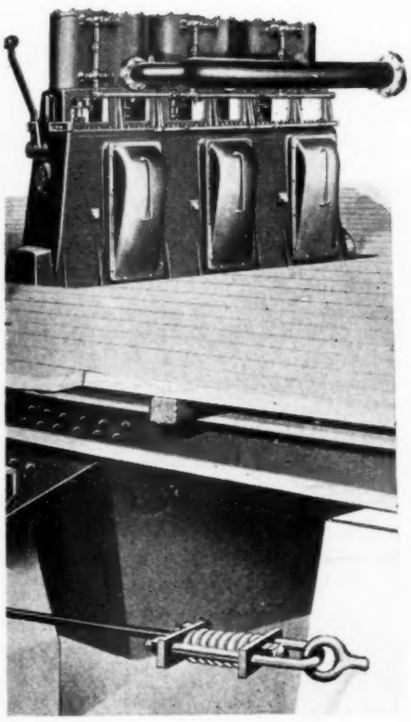

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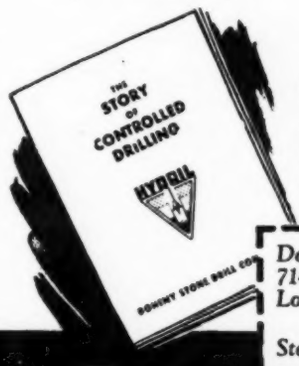

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"Standardization *of* Electric Power Rate Structure *for* Drilling *and* Production"

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ELECTRIC power for use in drilling or pumping oil wells is purchased at present under a multitude of rate schedules, many of which are incomprehensible except to electrical engineers, and it is very desirable that there be a standard price structure and simple purchase contract that anyone can understand.

The difference between electric power and other tangible and visible commodities renders very complicated the formulation of a standard rate structure. A few comparisons will illustrate this point.

Consider first an ideal purchase method for electric power as a basis and note how the various factors that have to be taken into consideration affect and control the attainment or otherwise of that ideal.

An ideal way to buy electric power would be to purchase it in the same way as any other product; namely, at so much per kw.-hr. (kilowatt-hour), without any other considerations, in the same way as one buys gasoline. It will be asked why this can be done without any difficulty, so let gasoline be compared — any other product would do equally well — with electric power.

Electricity, though invisible and intangible, is just as much a saleable commodity as gasoline or any other product.

Power With Other Commodities

The price per gallon of gasoline may be said to be regulated first at the refinery, by the cost of the raw product, plus cost of manufacture (this to include interest and depreciation, etc., in plant, overhead and so forth), plus a profit to the refiner. Secondly, price is controlled at the refinery by the market demand for gas, stocks available and refinery output. These factors go to make up an f. o. b. refinery price. The natural result of wide competition and a world-wide market is that f. o. b. refinery prices are more or less alike everywhere, automatically resulting in a basic rate structure for gasoline. Normally, then, the price for any given district is refinery price plus freight and handling to the point of delivery to the individual customer.

Now consider electric power. As in the case of gasoline, electric power could be sold at so much per kilowatt hour at the plant, taking into account in its production the same cost factors that govern a gasoline price, but the market is local and limited instead of world-wide and in many cases the power company has little or no competition except from other types of power.

Comparison of Plants

If the refiner has a demand for more than he can make, he is not compelled to enlarge his plant unless he wishes to do so.

An electric power company, being a public utility, is compelled to a very great extent by law to increase its plant to meet the demand. If gasoline sales fall in one district as the result of business depression, the refiner can ship his product to other districts or even foreign countries where a demand exists. The power company cannot do this. If the demand for gasoline decreases to that point where the price fails to return a profit, the refiner can shut down his plant and no one can complain or force him to continue operations. A power company cannot do this — it is not permitted to do so.

A refiner can take advantage of market conditions throughout the world and when conditions are favorable, can make more profit to offset the low profit or loss periods. A power company cannot do this. Its maximum rate of profit is controlled by law.

Consider the actual manufacture of goods and the location of plants. The refiner can choose the most advantageous points at which to locate his plant. As a result the cost of refinery operation may generally be considered as fairly uniform, which tends to make cost of product uniform or at any rate within close limits between high and low.

On the other hand the choice for location of a power plant is somewhat restricted and the power company cannot always choose the place where power could be most cheaply made and delivered to the point of sale. The result is that electric power production costs vary quite widely instead of being reasonably uniform. To illustrate: one power company generates power by hydraulic turbines and by steam plants, firing the boilers with gas from its own gas wells; another company operates a steam plant, using lignite coal from its own mine; a third company generates some of its power with a steam plant for which fuel oil is purchased; others more advantageously situated generate entirely by hydraulic power.

The generation of electric power by hydraulic turbines is cheaper than by steam; a gas-fired steam plant requires less labor and equipment than a coal-fired plant and an oil-fired steam plant comes in between the gas-fired and coal-fired plants. Generating costs are higher if the power company buys its coal, oil or gas than if it owns the mine or oil or gas wells.

Such circumstances cause considerable variations in the cost of generating power at electric plants. Therefore, that fixed standard or base rate for power f. o. b. plant which would enable the most unfavorably located plant to make a fair profit, would be unnecessarily high for the most favorably located plant.

Distribution and Sale to Customer

A refiner can sell his product over the entire world, but the area over which a power plant can sell its product is strictly limited. It is very evident that this fact alone

(Turn to page 106, please)

*Presented before the Fall meeting of the Texas-Louisiana-Arkansas district of the A. P. I. Division of Development and Production Engineering at Galveston, Texas, Sept. 5 and 6, 1929.

HERCULES TUBING HANGER and ANCHOR

REAL
Tubing Protection

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CROSS SECTION VIEW OF HERCULES TUBING HANGER
(Patent Pending)

This Hercules Combination gives the operator the maximum of tubing safety.

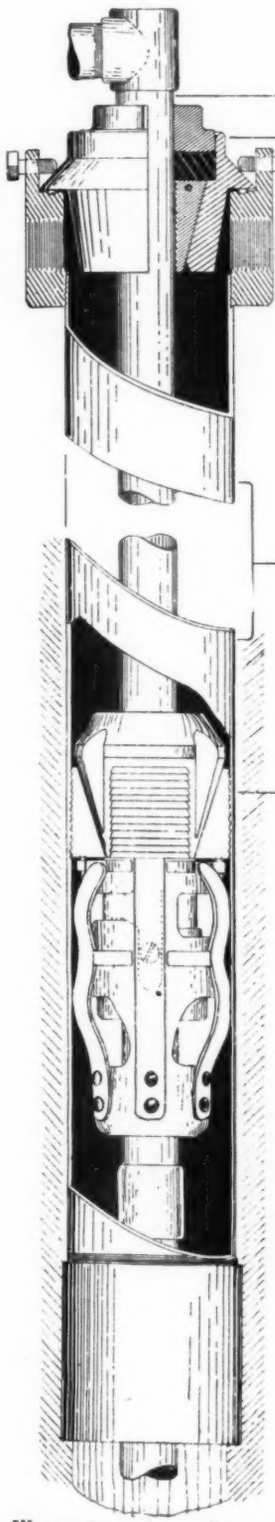

Illustration above shows Tubing Hanger and Anchor in position in the well.

The Tubing Hanger, made of forged steel, supports tubing at casing head, with slips that encircle the tubing. It is gas-tight and holds any pressure where gas or air is used for flowing well, or where vacuum is used. The Hercules Tubing Hanger has adjustable packing features and can be repacked without lifting tubing, saving time and labor in stringing up tubing line. Protects tubing from dropping caused by windstorms or fire, and from other accidents caused by pinched off collars at casing head. Small in construction, but sturdy, simple in design, yet complete, assuring absolute protection at small cost.

The Tubing Anchor placed on the tubing near the bottom of the casing prevents tubing from dropping should an accident occur as the slips are always engaged. Can be placed at any desired point within the casing and can always be controlled at the casinghead. When used in pumping wells, tubing accidents are eliminated. The Anchor is always set and tubing CANNOT DROP. Should tubing part when pulling it would simply stop in the casing without first dropping then catching, thereby eliminates corkscrewing tubing or jumping out at collars, or possible damage to casing. Also increases the pumping efficiency—the Anchor holding the tubing rigid gives you full benefit of the stroke of the rods within the tubing.

HERCULES TUBING ANCHOR
(Patented)

Let us explain more fully about this tubing protection.

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creates a fundamental difference to be overcome before the adoption of such a standard rate scale as now obtains in the sale of many other commodities.

The refiner can distribute his product by his own pipe lines — if this be advisable — by railroad, automobile truck, and by steamer or barge, on river, lake or sea. He has three regularly operated methods of transportation at his disposal — the power company has only one — its own distribution system. Within these three means, besides his own equipment, the refiner has available the duplicate equipment of other transport equipment owners, all of whom are competing for his business. Sometimes he can take advantage of extreme competition and ship his product by companies which are operating at the barest of profits and thus at a very low cost.

The power company does not get this opportunity. On the other hand, because of its responsibility to give reliable and steady service, it is compelled to install an expensive distribution system. If sales fall in a given district, the refiner can use his own transport equipment elsewhere: if he has automotive equipment he can deliver in a new area where sales can be made, or he can send his tank cars over another route at no great cash outlay. A power company cannot do this without considerable expense. Should sales die out in a given area, it has to dismantle its transmission lines and re-erect them in a new area.

Another radical difference in the distribution of electric power, as compared to other commodities, is the maximum or peak demand and "future demand" problem. For all tangible commodities, such as gasoline, it is possible to have local storage points from which a supply of the commodity can be quickly distributed within the area served by the district store. A power company cannot store surplus power at a district power substation. The transportation of gasoline to main district stores, which are analogous to power substations, can be carried out with a fleet of transport units working 100 per cent capacity — there is no need for transport equipment which is used only to handle peak loads. A power company must put in a transport system capable of carrying the peak load, which means that all the equipment cannot be operated to 100 per cent capacity continuously. In the case of future or increased demand, the same sort of situation arises. A small increase in gasoline transport units, working full time and carrying full load, is all that is required to take care of the situation, as against an increased transport or transmission system capable of handling all the maximum increased demand at any moment. This equipment will then, of course, carry the full load only part of the time.

The next item to be considered may be termed "customer costs." This is the expense involved in serving the individual customer. Deliveries made by railroad, steamer or outside-owned trucks may be neglected as in electric power distribution; only exceptional cases arise in which outside parties own the transmission lines. In wholesale delivery by company truck, the costs include loading the truck, driving it to the customer's place of business, unloading, and returning for another load, plus the cost of billing out the goods and collecting for same, etc.

In the case of the power company, the customer cost includes delivery of the power to the purchaser's property, reading the meter, billing and collecting the charges. In this case, however, a part of the power company's transport equipment — power line, transformer, substation, meter equipment, etc.— having sufficient carrying capacity to meet the customer's full requirements, is completely tied up for the sole use and service of the individual customer. In the case of other commodities, all the charges covering interest on the investment, unkeep, depreciation charges and so forth, are distributed over a number of customers because the equipment is not tied up full time for the sole benefit of one customer, whereas with electric power, part is so tied up and all the above charges covering the tied-up equipment are covered by one customer even though he does not make 100 per cent use of the equipment.

Next for consideration is the influence of the type of equipment required to transport the commodity and the country over which it operates.

The use of mobile equipment, such as trucks, coupled with the ability to store the product wholesale, so to speak, in central distributing stations covering given areas, and the ability to keep said equipment operating at full capacity, result in a lower investment and greater operating efficiency than is obtainable in electric operation which requires permanently installed equipment large enough to carry the peak load. In the event of a breakdown in the first case only a small part of the transport system is put out of commission. In the case of power transmission possibly the whole system may be put out of commission — hence the possible loss is much more serious.

In addition to all the above, the distribution of electric power involves certain peculiar risks which are a source of much additional expense not experienced by the distributors of other products. At Wink, in West Texas, for example, lightning on one occasion hit the main power line, burned out several transformers and a number of meters and caused other damage running into thousands of dollars.

Bound up with the question of a standard rate schedule is another very important point which power companies must rectify and that is the question of standard voltages for high tension lines. At present current is supplied to fields at 2,300, 4,000, 6,900 and 11,500 volts, for example. A company operating in several areas may have available for transfer from one area to another transformers which, however, cannot be used because the voltage is not the same in both areas. Two companies may be supplying power in one area and it may be desired, for good and sufficient reason, to switch from the service of one to the other, but unless both companies supply the same voltage, it cannot be done without purchasing other transformers. Serious efforts are being made in order to standardize equipment; a standard voltage should be decided upon and demanded of the power companies; if they failed to comply the use of their power should be discontinued. All this has to be taken into consideration in rate making.

It may be well to call attention to the question of contracts. The several clauses in electrical contracts vary widely. Much would be gained by simpler and uniform contracts.

It may be asked why there are different prices per kilowatt hour of demand and different amounts of free kilowatt hours per kilowatt of demand? Why cannot the demand charges be universally the same and the free kilowatt hours per kilowatt of demand the same or even why any demand charge at all? Why varying rates for different types of service?

A demand charge is necessary because a power company operates under rules and regulations which require that in serving a customer it must be prepared at all times to do so and consequently must have the necessary equipment to supply the demand. Therefore, if a customer demands a certain supply of current, he is charged for it, and if he uses that full demand 100 per cent of the time, the

Turn to Page 109 Please

power company's equipment is being used full time, and is not lying idle, but if the customer does not use it 100 per cent, then the power company has equipment which cannot earn profit 100 per cent of the time, but which has been installed in compliance with law in order to meet the stated demand at any moment.

Power companies have these varying demand rates and amounts of free kilowatt hours for the following reason: As in any other business, a power company must earn profit on its investment. Now suppose a power company lays two main lines 200 miles long, one north and the other south from the power station. The north line passes through an undeveloped county with arid stretches such as West Texas with towns sometimes 50 miles apart and little or no development in the country between them, while the south line passes through a fully developed country with towns at short intervals having industries. It is assumed that the two lines cost the same to install.

Capital investment is written off in a certain number of years — the length of time dependent upon various circumstances. It will be quite evident that the south line will have a much greater earning capacity per mile than the north line because the opportunities to sell power are many times greater than are possible in the north line. Upkeep and depreciation being the same, it is evident that in order to write the two lines off in the same time, it will be necessary to charge more per kilowatt hour for the power supplied through the north line than the south line. This is accomplished by the varying demand charge and free kilowatt hour per kilowatt of demand.

In reality this method is used because of a psychological effect on the consumer. Suppose the demand charge and free kilowatt hour charge were the same on the imaginary north and south lines. To earn the sum required to make the lines profitable, customer "A." on the north line and "B." on the south line, both using the same quantity of current, would both pay say $2.00 per kilowatt of demand and both would get 50 kilowatt hours free for each kilowatt of demand, but the sliding scale part of "A.'s" bill would read, say "for next 40 kilowatt hours per kilowatt of demand, 3 cents per kilowatt hour; for next 5,000 kilowatt hours, 2.5 cents; for next 5,000 kilowatt hours, 2 cents; for all in excess, 1.75 cents"; whereas "B.'s" bill would read, "for next 40 kilowatt hours per kilowatt demand, 1½ cents; for next 5,000 kilowatt hours, 1¼ cents; for next 5,000, 1 cent; for all in excess, .75 cents." Now it will be seen that if "A." and "B." get together and compare contracts, "A." would immediately feel he was being overcharged, not understanding the circumstances, as explained previously, causing the sliding scale part of his bill to be so much more than "B.'s". To overcome this situation, the varying demand rate and free kilowatt hours per kilowatt demand were evolved, under which "A." and "B." both find the sliding scale section the same and only the demand rate and free kilowatt hour different. This does not mean much to "A.", because he cannot visualize the cents per kilowatt hour it represents, and he makes no complaint — and much controversy is eliminated.

So much for the power company's point of view. Consideration of the consumer's point of view shows that he is not particularly interested in the fact that the power company had laid a line into his territory and that it has to charge certain rates in order to render an adequate return on the investment, but he is interested in knowing just what makes up the rate charged. He wishes a brief and open explanation, without camouflage, that anyone can understand. The resentment engendered by a deceptive method of rate making must be eliminated. The customer understands that in a new and undeveloped region, higher rates may be necessary for a time, but he can see no reason for hiding this fact in the rate structure.

The purpose of this paper is not to discuss what the rate should be, but to create discussion that may bring about a simple and readily understood rate structure.

The following suggestions might be taken as a basis. It will be admitted that the rate structure of any given power system must be determined by the conditions affecting that particular system. The base might be a certain sum per (name plate) horsepower rating of the motor, plus a certain sum per kilowatt hour of consumption. Necessarily the power company would include all such items as transmission costs, power factor, load factor, fuel clauses, etc., when setting such a rate for any given district. It is appreciated by the consumer that rates might vary throughout different districts, but the power company must be quite frank — it must convince the consumer that the charges made are warranted. The consumer will be much better satisfied if he knows exactly what rate he will actually pay when he signs a contract instead of finding out afterwards that some clause, printed in small type, has affected his bill in an unexpected way.

The above mentioned problems, factors and difficulties must be taken into consideration and an equitable solution must be found in order to formulate a standard rate structure that would be economically sound both for purchaser and supplier.

It is the writer's personal opinion that a committee from the A. P. I. should meet a committee from the power supply companies and go into the whole question of rate structures. Such a conference should result in a better understanding of the other party's problems and in a mutually satisfactory schedule of rates. In many cases the present rates are unsatisfactory to the oil operators and while electric power has many advantages, the operators cannot afford to use it on account of prohibitive costs. In order to obtain the oil operator's business, the electric power companies must improve their methods of rate making so that they will be uniform and competitive with other forms of power used by the oil industry, otherwise the oil operators will obtain the advantages of electric power by erecting their own electric generating plants. With modern equipment now on the market, it is possible, even on quite a small scale, to erect semi-portable or permanent plants and supply power at the well at less cost than power companies will now supply it to the small or medium demand customer.

Discussion of Durward Paper

FIELDS (Shell Co.), wonders why power rate structure is so complicated. Why can't a more simple rate structure be worked out which can be understood by the average executive and field superintendent without recourse to the aid of a technically trained electrical engineer. In West Texas the rate schedules are beyond the comprehension of the ordinary field man. The Arkansas P. & L. Co. has simplified its rate structure and electric power companies in West Texas could well afford to follow their example.

MOORE (Humble O. & R.), gave a detailed explanation of demand charge and power factor, and likened them to railroad shipping freight charges. (At this point it was decided to appoint a committee, composed of engineers from the oil companies and engineers from the power companies, to consider the simplification of power rate schedules.)

SECO

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The Seco Straight-Shot Valve is made for all makes and sizes of pumps. It is particularly adapted to slush, hot and cold water, gasoline and hot oil up to 300 degrees. All parts are made of high carbon, forged steel except the inserts, which are of a special make and used exclusively in Seco Valves. They have shown in numerous instances that they give over 100 per cent more service than any insert ever used. The Seco Valve is by far the most economical valve on the market, according to all tests.

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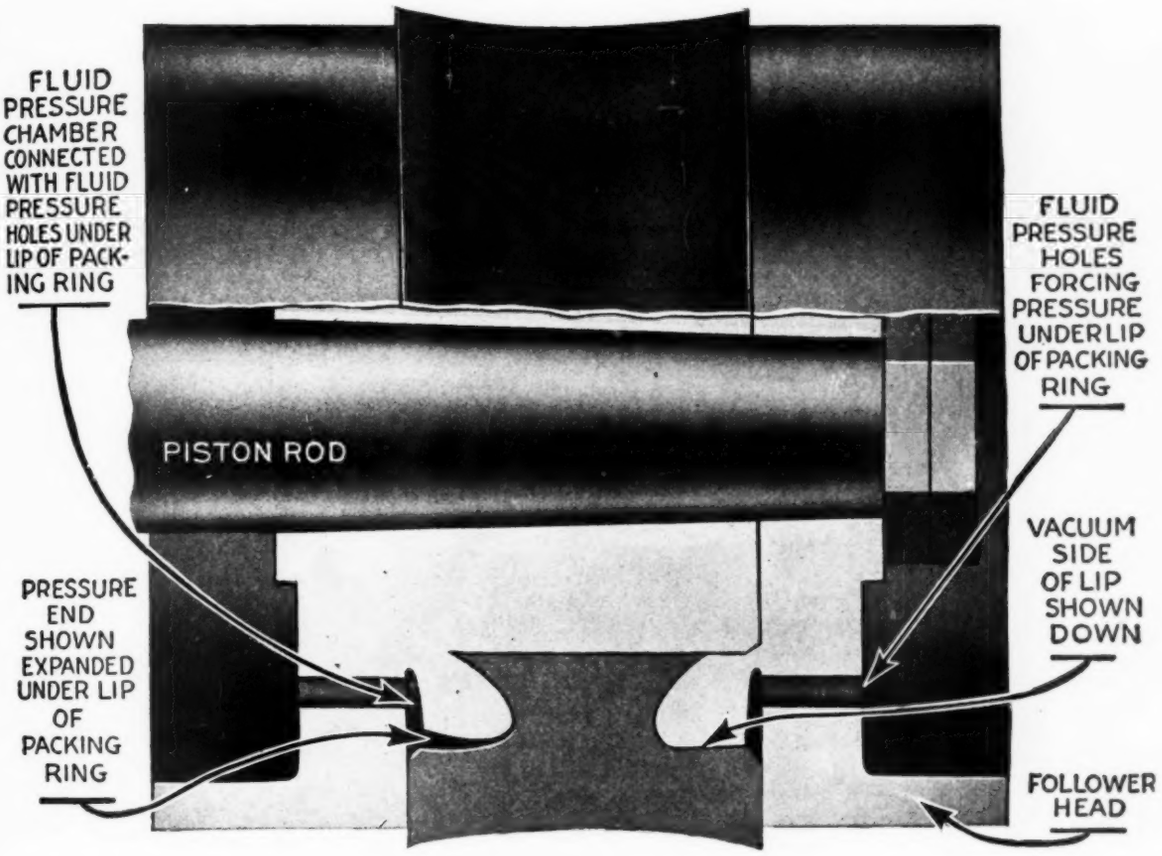
FLUID PRESSURE CHAMBER CONNECTED WITH FLUID PRESSURE HOLES UNDER LIP OF PACKING RING
FLUID PRESSURE HOLES FORCING PRESSURE UNDER LIP OF PACKING RING
PISTON ROD
VACUUM SIDE OF LIP SHOWN DOWN
PRESSURE END SHOWN EXPANDED UNDER LIP OF PACKING RING
FOLLOWER HEAD

The Kibele Self-expanding and Frictionless Piston is made for rotary drilling slush pumps, mine pumps, boiler feed and oil pumps. It is made to fit any pump and no special piston rod is required. The working parts of the piston are shown in the illustration above. The rubber is compounded to our own specifications. Pistons are of exceptionally close gray iron with outer surfaces chilled. Kibele Pistons are recognized as superior in oil fields the world over.

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HOUSTON

Use and Care of Sucker Rods

By **R. H. REESE,** ***Planning Engineer, Atlantic Oil Producing Co., Dallas, Texas.***

IN an effort to ascertain the extent of agreement between general field practice in the use and care of sucker rods, and the recommendations in Poster No. 7 of the American Petroleum Institute, a questionnaire was mailed a large number of operators in Texas, Arkansas, and Louisiana. A paper on "Care of Sucker Rods" was read at the last meeting of the Midland Chapter by E. S. Durward of the Shell Petroleum Corporation, Dallas, Texas. Copies of this Poster and the paper by Mr. Durward are available here for distribution. Both of these are excellent and a careful reading of them is advised.

The questions of the questionnaire with summarized answers were as follows:

Question No. 1. *Method of Installation in Well?* All replied—boxes and pins were cleaned. Four replied—twenty-four-inch pipe wrenches were used; four replied—rods were made up in doubles before running; three—rods were run in singles; one—rods were run in trebles; eight replied that precautions were taken against bending.

Question No. 2. *Precautions Against Bending?* Seven replied—rod hangers were used; five replied—rods were laid out on walk; two replied—rod racks were used; one replied—lower girt in derrick was removed to allow carrying rods out without bending.

Question No. 3. *Do You Use Protectors in Crooked Holes? What Type?* Ten replied—"Yes." Three—"No;" four—"No crooked holes;" five replied—"Wood;" three—"Metal;" two—"Wood or metal."

Question No. 4. *Do You Allow Hammering to Break Joints?* Three replied—"Yes;" three—"No;" four—"Occasionally;" one—"Only on shallow wells;" one—"rarely ever allow but do not think it as damaging as generally considered;" one—"Do not encourage it." At this point, let us refer to paper by Mr. Durward mentioned earlier. He states, "I know of one area where a company had excessive pin breakage, out of sixty-four broken pins examined there were sixty-two of the boxes measured long on one side and all showed evidence of hammering."

Question No. 5. *Protection of Rods When Not in Use, Particularly Threads?* All replied—keep rods racked straight; five—keep joints oiled and covered with burlap; five—keep joints oiled; three—paint joints; one—clean and paint joints.

Question No. 6. *Protection Against Sudden Loads (Inertia or Impact Loads)?* Four replied—"None;" five—"Counterbalancing;" three—"Counterbalancing with maximum stroke and minimum speed;" two—"Shock absorbers;" one—"Use special hanger but see little good from it."

Question No. 7. *Protected Against Whipping and Dragging While Hauling?* Four replied—"Do not drag rods;" two—"Move in singles with truck and trailer;" one—"Haul in bundles and kind securely;" one—"Use flat truck beds;" one—"Fasten to avoid sag in middle and whipping at ends;" one—"Load carefully with pins on front end of truck or wagon."

Question No. 8. *Any Protection Against Corrosion?* Eleven replied—"None;" four—"Use of grease or oil;" two—"experimenting with galvanized rods."

Question No. 9. *In Your Opinion How Can the Useful Life of Sucker Rods be Increased?* This question indirectly embraces the preceding eight questions but allows a wider range for replies. Six replied—"Keep threads clean;" six—"Proper counterbalancing;" four—"Keep joints well made up;" four—"Slower pumping motion;" three—"Use of elevators;" two—"Hanging rods in derricks;" two—"Keeping guides changed when needed;" one—"Weeding out all damaged rods;" one—"Keep derrick in good condition;" one—"Remove complete string of rods after fishing;" one—"Do not hammer joints;" one—"Use proper length of stroke;" one—"Use larger rods on heavy wells;" one—"Plug off salt water;" one—"Treat it like it was the last string of rods on earth."

The large number of replies to this questionnaire, coming as they did from men directly in charge of field work, proves a very great interest not only in this subject but in the conservation of materials generally. A willingness to co-operate and exchange ideas and information is present today that was lamentably lacking a few years ago. At present it should not be difficult to ascertain the generally accepted theory and practice in any line of the oil-producing industry. Probably the major task today is training the men to perform their work correctly until they know no other way.

*Presented before the Fall meeting of the Texas-Louisiana-Arkansas district of the A. P. I. Division of Development and Production Engineering at Galveston, Texas, Sept. 5 and 6, 1929.

Merco-Nordstrom Offers $500 Cash for Slogan

OFFERING $500 in cash prizes for the best slogans to be submitted by anyone prior to December 31, the Merco Nordstrom Valve Company has launched a slogan contest that is expected to arouse much interest among petroleum engineers and others acquainted with their type of lubricated valves. The company is seeking an appropriate slogan that can be used in connection with the publicizing of their valves and offers to forward a catalog to anyone who wishes to try their genius in creating a slogan of not more than 10 words. The slogan can pertain to the service or function of Nordstrom Valves or can be any "saying" that suggests the successful service of the valves in various industries. At the present time the slogan "Won't Leak—Won't Stick" is used.

The first prize is $250.00 for the best slogan submitted. The second prize is $100.00. The third prize $50.00. The next four prizes, $10.00 each, and the next twelve prizes, $5.00 each, a total of nineteen cash prizes.

Everyone except employes of the company are eligible to enter and anyone can submit as many slogans as desired, none to be more than ten words in length.

The Nordstrom valve's principal feature is its excellent lubrication. It is of the plug cock type and is highly leak resistant because the plug is surrounded by a film of lubricant under pressure that prevents any material in the line from leaking past.

Those who desire to enter the contest are urged to send for a catalog, which gives full details regarding the valves, or to consult with engineers in the industry for details of the valves' merits. The company may be addressed at 343 Sansome Street, San Francisco.

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MODERN METHODS *Include* INSTALLATION *of* PLANTS *for*

Recovering Gasoline Vapors *in the* Refinery

IN order to minimize evaporation losses in refineries manufacturing or storing any appreciable quantities of gasoline or using process naphtha in blending or filtering operations the installation of a vapor recovery unit even in small plants is almost imperative both from the standpoints of economy and good operating practice. In recent years most refineries have installed these units or replaced their old inefficient equipment with the modern types. A great deal of progress has been made in the design of this type of apparatus to recover uncondensed still vapors and vapors from blending tanks or gasoline cars. The present-day installation is very compact and can be quite efficiently operated with low labor cost. The value of the recovered naphtha will usually offset the cost of the plant in a short time.

Airplane view of the Skelly Oil Co.'s refinery at Eldorado, Kansas.

The operation of the modern unit is simplified by the use of many automatic devices and concentrated control. The use of efficient fractionating equipment makes it possible to produce a naphtha of any desired end point. The size of the various elements entering the construction of an installation depends upon the quantity of gas to be treated and the gasoline content. If the gas is reasonably clean and free from hydrogen sulphide the operation is continuous over a long period of time without shutdowns.

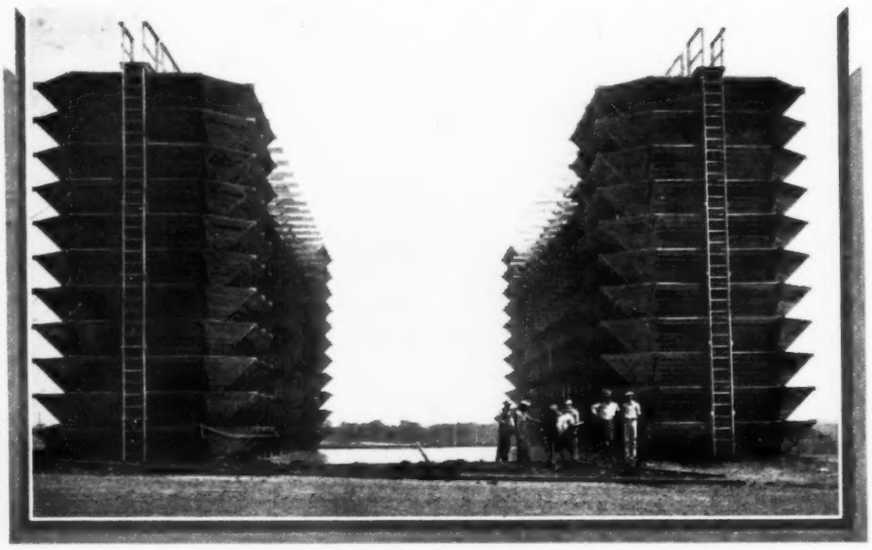
In many cases the gas from the cracking or crude stills contains an appreciable amount of hydrogen sulphide that makes it necessary to scrub the incoming gas in several towers with caustic or doctor solution to prevent corrosion of the equipment and to eliminate shutdowns. The sweetening of the gas becomes automatic and does not complicate the operation. The recovered naphtha is usually sour and is generally blended and treated with the regular run of gasoline distillate.

Both compression and absorption types of recovery plant are used in refineries. If the recovered gas is highly compressed in the first type it usually contains considerable propane and butane and should be stabilized or weathered before blending into motor gasoline. There is less chance of this condition in the absorption type, which is more frequently used in the refinery. For the absorbent oil the refiner can make a special cut from the crude and acid-treat and sweeten it, or a kerosene distillate can be used. The purpose of the acid treatment is to reduce the olefines and other unsaturated compounds which might polymerize in use and gum up the absorber.

In collecting the gas from the various sources about the refinery it is important that the air content is as low as possible. This can be done by avoiding leaks in the system and by avoiding a vacuum of more than two inches of water on the system. Storage tanks should be properly vented with liquid seals for safety. With reasonable care and attention remarkable results may be obtained.

The cooling towers shown here are installed in a natural gasoline plant of the Carter Oil Co. in the Searight pool of the Greater Seminole field of Oklahoma.

This is a very unusual installation and was built to suit local conditions. The wind is generally from the north, and, to limit the amount of cooling water which would be blown away, two cooling towers were placed as illustrated. (The picture was taken looking east.)



Cooling towers of the Carter Oil Co.'s gasoline plant in the Searight pool of Oklahoma.

The adjacent side of each cooling tower was eliminated and a water pond was constructed between them. By this arrangement any water which may be blown from a tower finds its way either to the other tower or else into the pond.

The men in the photograph are connecting up water lines just before the installation was put into service.

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Blackor can be applied with the carbon electric arc by your own welder or in any job shop. It makes a perfect bond with the steel and covers the entire cutting surface. It eliminates the need of a primary hard-facing material and the solid Blackor surface is more abrasion-resistant than if packed solid with inserts.

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Blackor comes in 5-lb. cans and complete working instructions are furnished. Can be applied at the rate of 11/12 square inches per minute. The genuine standard abrasive resistor.

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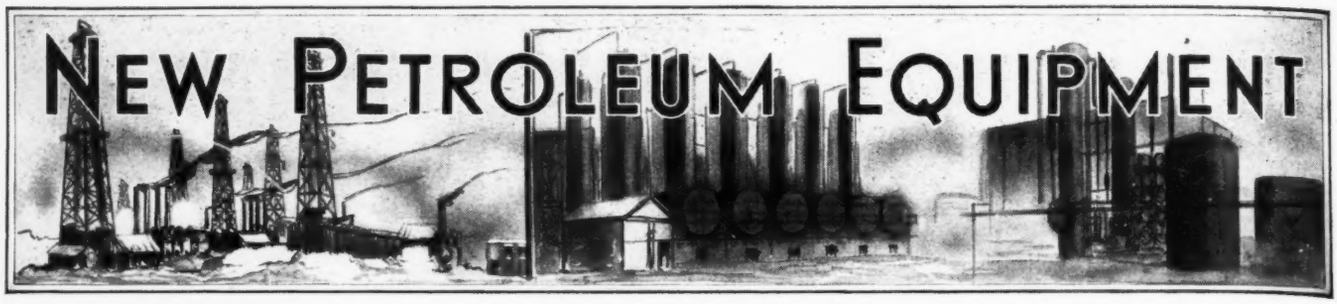
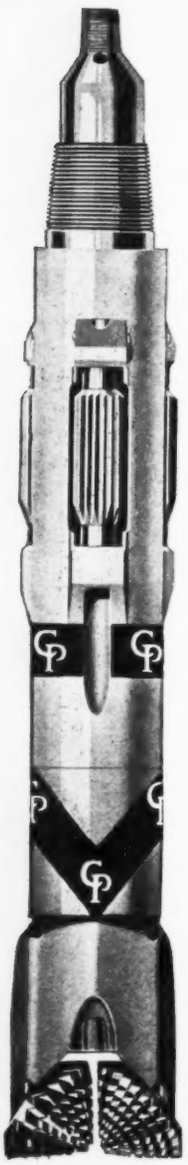




THE Chicago Pneumatic Tool Co. of New York, with branches in all oil centers, has just introduced a new rock bit for drilling oil wells which will be known as the "CP Tucone rock bit". This bit is said to be the culmination of five years' intensive study and experiment on the part of the company, and it has been stated that one million dollars has been expended in its development and for special manufacturing equipment.

The accompanying illustration shows the general construction of the bit. It consists of a one-piece manganese steel casting reamer body, and a one-piece manganese steel casting bit body.

KENNEDYE-PLUMB Corporation of St. Louis, Mo., has distributed a most ingenious and original piece of trade literature which is the idea of C. B. (Boots) Kennedye. The folder has a distinct personal touch by the insertion of the name of the individual to whom it is sent. It describes various functions of the KP straight hole line of tools.

THE Moon Manufacturing Co. of Chicago has mailed out descriptive bulletin No. 16 devoted to the new type 12-A, 2 KW Turbo generator. The makers claim that this piece of equipment embodies the very latest design of engineering principles together with 20 years actual experience in building generators.

New Wrapper for Underground Pipe

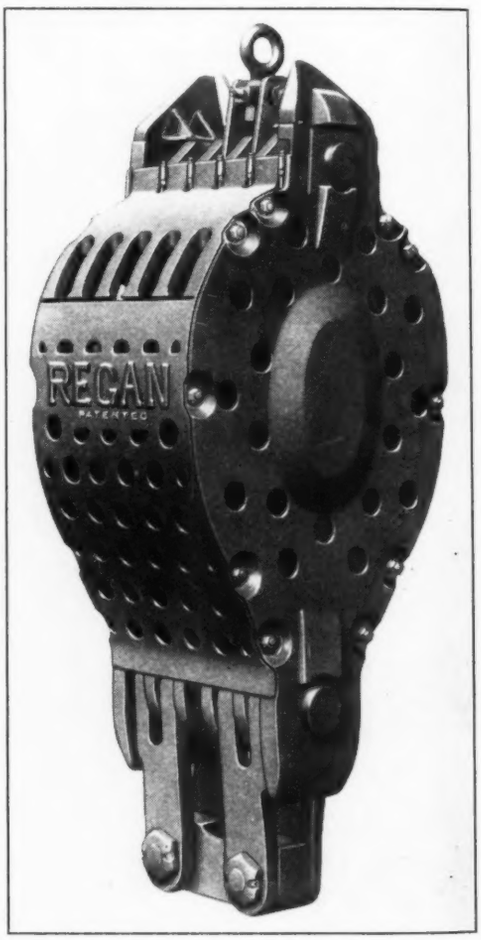
THE Dearborn Chemical Company's laboratory and engineering departments have been working for some months with other groups interested in the production of a mineral base wrapper for underground application on pipe lines. There is a feeling on the part of some engineers, charged with the preservation of pipe lines, that a mineral base wrapper, properly treated, is superior to fabric wrapper for underground application. This has led to the development of NO-OX-ID-IZED Asbestos Felt Wrapper, which is flexible, water-proof and practical. It never dries to a cracking point, and does not become powdery under alternating wet, dry, hot or cold exposures. This NO-OX-ID-IZED Asbestos Felt Wrapper weighs approximately 1.34 pounds to the yard, and is sold in rolls of 50 lineal yards by 36 inches in width. It may be ordered cut to strips of width desired.

Another new development by this company is a heavier NO-OX-ID-IZED Fabric Wrapper (Gray), which weighs about three-quarters of a pound to the yard, as against a weight of about six-tenths for the NO-OX-ID-IZED Fabric Wrapper (Brown), which has been used for years with great success both under and above ground. The heavier fabric wrapper has added physical and chemical properties and will meet extreme soil conditions.

These new wrappers, together with NO-OX-ID "G Special," which have been thoroughly proven in service, will be of interest to field engineers having to cope with extreme soil conditions.

Regan Has Giant Traveling Block

ANTICIPATING the need for heavier equipment to permit of high speed and the handling of extreme loads in extra deep drilling, the Regan Forge and Engineering Company has brought forth a 76-in. traveling block that is believed to be the largest ever constructed. It is a mammoth block made with 4 and 5 sheaves, the latter assembly weighing approximately 7,400 pounds.



The sheaves are 39½ in., and embody the well-known Regan dual-bearing principle, with integral pin for each sheave. The sheaves are set stagger fashion, making the block very compact, even with the use of the ten bearings in a 5-sheave assembly. This block presents a workman-like appearance and an improved guard arrangement whereby there are no projections that can "hang up." The finger guards are of

extremely heavy construction that will withstand extreme abuse.

An improved heavy duty lower bale, of roller clevis type, is incorporated. Various tools can be attached and detached without the necessity of tearing down the block. The straps are of improved type and all contacting parts are machined so that the most rigid assembly is provided. The block is of such extreme weight that it will easily spool when coming up light. The anti-friction bearings permit fast speed, regardless of the load carried.

Certain parts of the block are heat-treated and the sheave grooves are A. P. I. specification. This block is being rapidly adopted as standard equipment by the drillers of the deepest wells and the design is expected to prove satisfactory in all fields where great loads are handled.

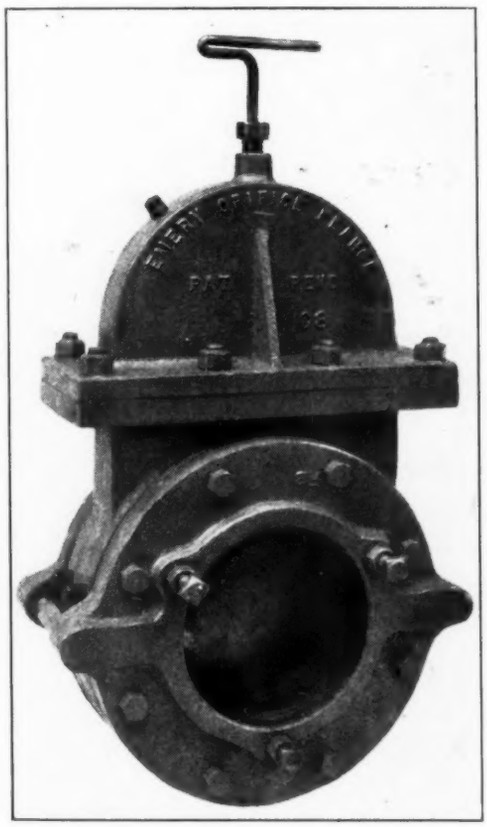
Regan Forge and Engineering Company also build a 54-inch and 62-inch traveling block, embodying the same basic principles, and these two types have been in service for many years.

Announcing a New Removable Orifice Plate Flange

THE general advantages of an orifice plate flange which permits orifice plates to be changed without a by-pass have been well recognized as a saving in time and money.

B. V. Emery & Company, Tulsa, Okla., announces a new and improved flange for low pressure service which has been thoroughly field tested during the past six months, and has entirely proved the following specific advantages:

(1) Light weight (8-inch weighs 300 pounds with C. F.



B. O.). (2) Low plate cost (special plates are unnecessary; regular thin plate is used). (3) Positive centering of the orifice plate. (4) Plate bearing surfaces automatically cleaned every time plate is changed. (5) Jack screws spreading companion flanges facilitate installations. (6) Simplicity—The same parts which clamp the plate in the body also seal off the upper plate chamber when orifice plate is removed. (7) No danger of plate distortion in using regular thin orifice plate. (8) Narrow face-to-face dimension, preventing "nozzling" of flow. (9) Upstream flanges positively centered to body and not dependent on bolts to line up. (10) Low initial cost.

Star Has New Machine

IN the new Type K the Star Drilling Machine Co., Akron, Ohio, offers a complete lease maintenance machine for 2,000-foot work, built into a mast of 30,000-pound capacity. All working parts are of rugged construction, yet the complete machine weighs only 8,800 pounds.

The Type K machine is recommended for cleaning out, pulling rods and tubing, drilling wells deeper, pulling casing, etc. It can be used for new drilling up to 800 feet of 6-inch hole. It is adaptable to lease jobs.

A NEW office has been opened in Atlanta, Ga., by the Merco-Nordstrom Valve Company to serve that district. It is located in the Healey Bldg.

"THE New Way" is the simple title of a very interesting booklet that has just been issued by the A. O. Smith Corporation, Milwaukee, Wisconsin. It describes briefly the Smith Welding Process as applied to the manufacture of pipe. It is claimed that perfectly round, straight joints, of extra long lengths, and any thinness, can be produced by this process. In addition to covering interesting details of manufacture and new improved methods of loading pipe, the booklet contains interesting engineering data which should be in the files of anyone having anything to do with pipe lines or pipe line construction.

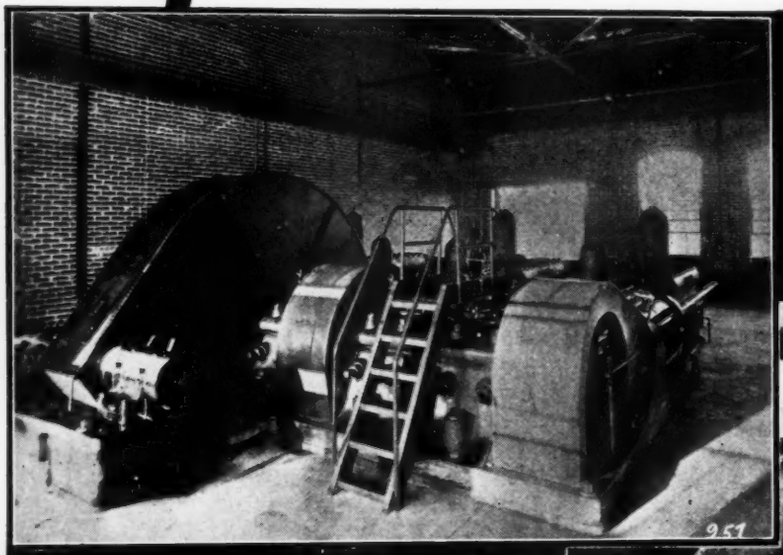
Zero Hour Duplex Bomb

"THE last word in oil well time bombs," is the claim of the Zero Hour Torpedo Company, Tulsa, Okla., for its latest Duplex model recently placed on the market. Over six thousand of their earlier models, embodying a single watch and one electric circuit through two electric blasting caps, have been successfully used for exploding "shots" of nitroglycerine in oil wells all over the world. The new Duplex model, though of the same size as earlier models, contains two watches, each connected through a separate circuit to two blasting caps, connected together in parallel. Thus, in effect, two timing mechanisms, each independently powered by its own watch, are enclosed in the same metal, fluid-tight container which formerly held one only. The manufacturer believes that, in view of the extremely small percentage of failures recorded for its single-watch bombs, failures of the Duplex will be reduced to an infinitesimal minimum.

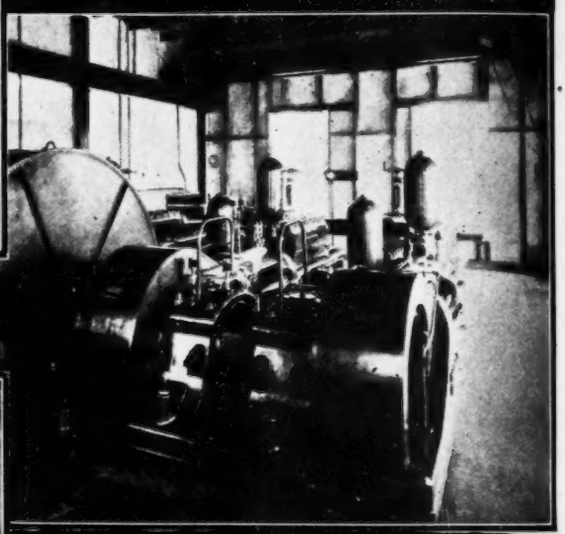
Among other new features is an improved spring contact or "firing pin," which permits the hour hand of the watch to be moved past it, either forward or backward, any number of times, as in testing, without variation of the firing time from the zero hour at which the pin was originally set. Another is the incorporation of "plug and socket" connectors for connecting the blasting caps to the timing mechanism.

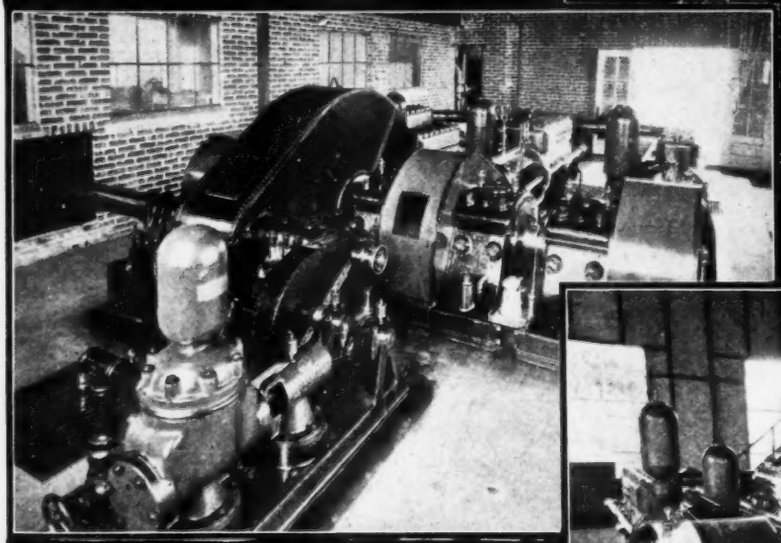
(Turn to page 120, please)

OKLAHOMA Pipe Line Company

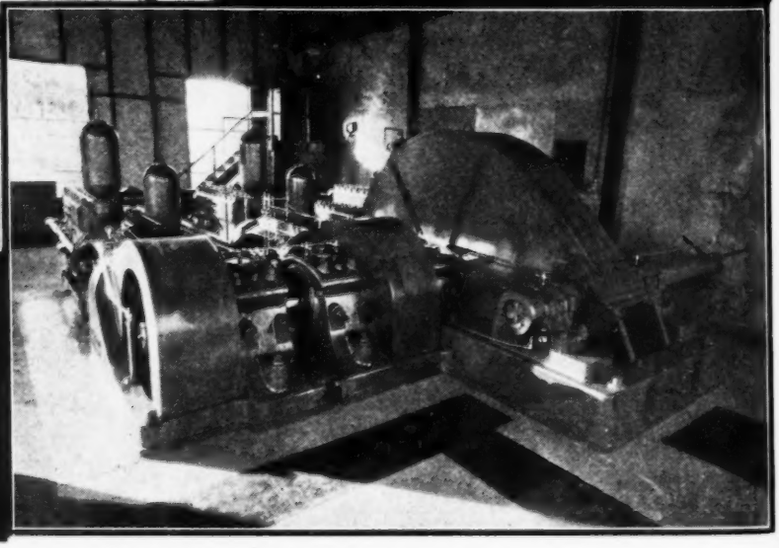


A 6″x36″ Prescott motor driven triplex pump, 40,000 bbl. capacity, in the Council Hill, Okla., station of the Oklahoma Pipe Line Company. Below is shown a 6½″x24″ Prescott motor driven triplex pump, 30,000 bbl. capacity, at Lima, Okla., station of that company.



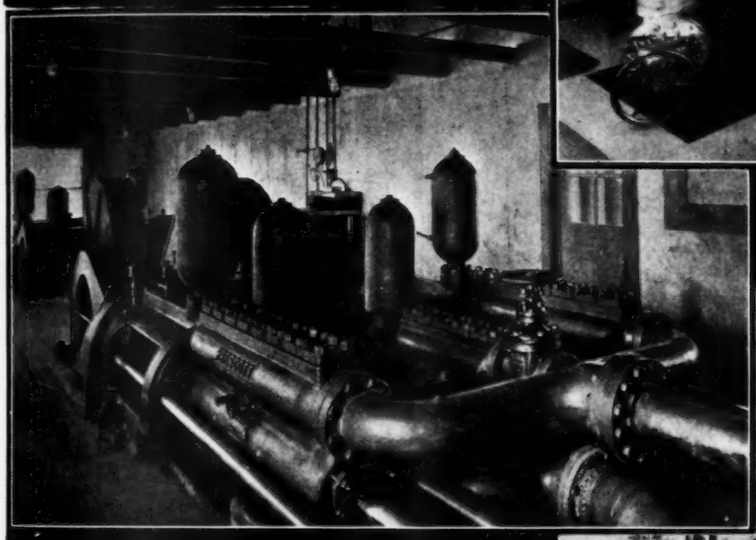


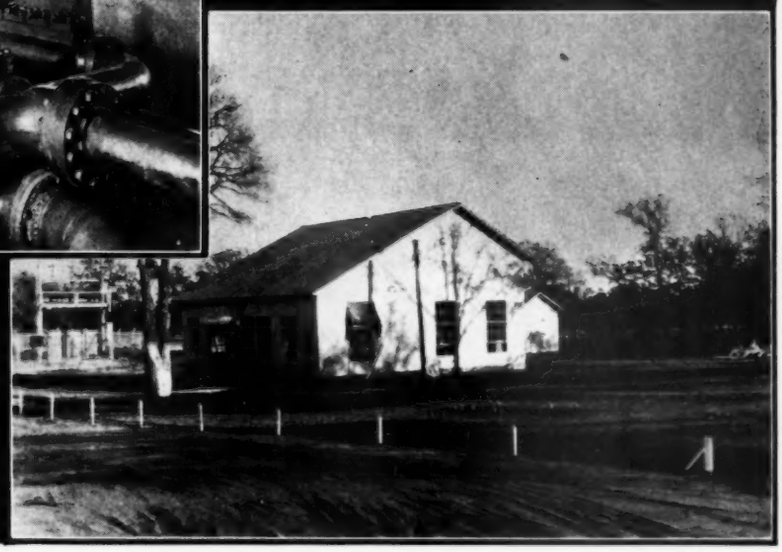
Above is a 6″x24″ Prescott triplex pump, 25,000 bbl. capacity, at Ralston, Okla. The photograph at the right shows a 6½″x24″ Prescott motor driven triplex pump, 32,000 bbl. capacity, in the Ardmore, Okla., station of the Oklahoma Pipe Line Company.



When writing THE PRESCOTT COMPANY *please mention The Petroleum Engineer*

At the left is a 4½"x12" Prescott motor driven duplex pump, 5,000 bbl. capacity at Mounds, Okla. Below is a 6½"x24" Prescott motor driven triplex pump, 32,000 bbl. capacity, in the Ft. Townsend, Okla., station of the Oklahoma Pipe Line Company.





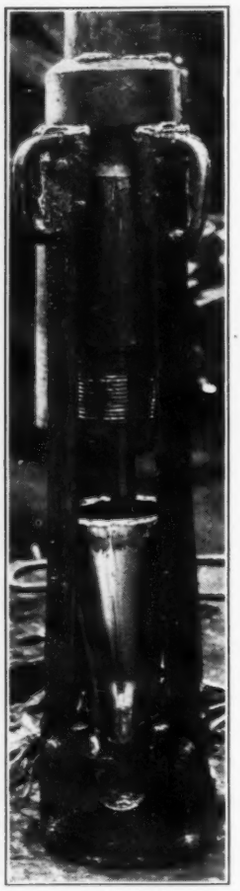
A 5½"x24" Prescott motor driven duplex pump, 12,000 bbl. capacity, in the Bowlegs, Okla., station. At the right is the Ardmore station of the Oklahoma Pipe Line Company. These are some of the many stations of this company equipped with pumps manufactured by the Prescott Company, Menominee, Michigan.

Uses PRESCOTT MENOMINEE PUMPS

PE10-5—Gray

When writing THE PRESCOTT COMPANY *please mention The Petroleum Engineer*

Bettis Protectors Have Wide Use



PRIOR to 1928, excessive friction was apparently the one insurmountable problem of deep rotary drilling. As depths were increased in search of deeper sands, this problem intensified and engineers exerted every effort to overcome the problem.

In the early spring of 1928, a simple anti-friction device made its appearance, known as the Bettis protector. Since then more than 200,000 have been placed in service in every rotary drilling field in the world, according to the manufacturers, and practically every deep drilling well is now equipped with them.

The protector consists of rubber only. It is of special compound, no metal being used in its construction. It snaps securely upon the drill pipe and prevents contact of pipe with casing. It is also used on tubing with good results. The protector is likewise used in the groove of Hopkins anti-friction tool joints and collars.

Among the infinite number of advantages claimed for these protectors are: Reduction in friction, protection of casing from rapid wear, protection to tool joints and collars, drilling of straighter holes, better control of drilling, fewer fishing jobs and twist-offs, faster drilling, reduced pumping costs, more flush production, less strain on drilling equipment, saving in brake-band lining by reason of the fact that the pipe floats in, longer life to wire lines and greatly reduced vibration.

The protectors are manufactured by Patterson Ballagh Corporation, Insurance Exchange Building, Los Angeles, and the mid-continent sales are under the direction of the Bettis Sales Company, with headquarters in Houston. A catalog describing the advantages of these pioneer pipe and casing protectors may be procured from the manufacturers.

Principle and Operation of "Apex" Revolutionizes Stuffing Box Idea

THE new Apex Stuffing Box for polished rods, recently introduced by the Oil Well Improvements Company of Tulsa, originators of the control casing head and the roller oil saver, marks another revolutionary change in the control and operation of pumping wells.

The Apex box is an entirely new departure in stuffing box construction and operation. There being but four parts to the Apex box, it has no bolts, screws, springs, or other trick pieces. The device embodies the slotted rubber idea of the roller oil saver as well as the complete side pressure principle for adjusting the packing against the polished rod.

The box consists of a central core or body with packing chamber for four inches of packing rubber which straddles most ordinary rod troubles, packing off either above or below pits and scores. The box is heavily babbitted above and below the packing chamber, guiding the rod and relieving the packing of side pull. The rod never touches anything but babbitt and rubber.

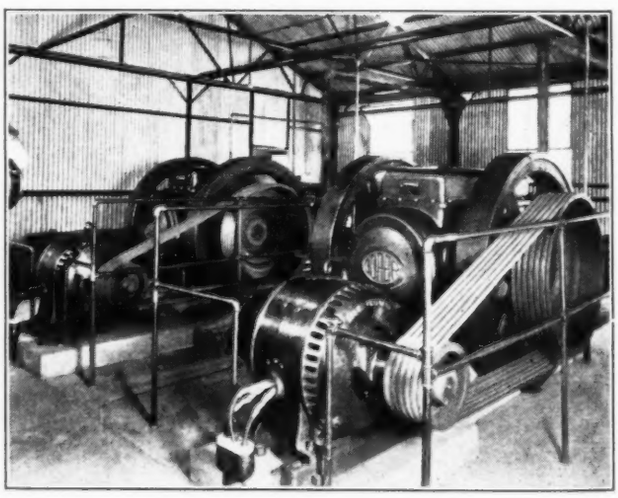
The conical cover, threaded down on the core of body,

automatically adjusts the followers and effects a uniform pressure of rubbers against the polished rod. No wrenches are needed for adjustment. All parts, core, cover and followers, are interchangeable regardless of rod and tubing size.

The Apex stuffing box withstands five hundred pounds cold water pressure without leaking, and being simple in principle, strong in construction, and automatic in operation, the device is designed for hard service and low maintenance and pumping costs.

The design provides three safety factors against burning up the packing and injury to the rods from lack of lubrication — lubricating slots in the packing rubbers; a graphite composition in the rubber, and a lubricating chamber in top of the box. The Apex stuffing box is the creation of Alf G. Heggem, inventor of the control casing head, roller oil saver, and numerous other devices of general use in the petroleum industry.

THE Cooper-Bessemer Corp. of Mt. Vernon, Ohio, has distributed exceptionally attractive booklets describing the Cooper Type 16 compressors. The compressor pictured below is driven by an Allis-Chalmers motor, connected by a Tex-Rope drive.



According to the Cooper-Bessemer Corp., many of these units have been put into service, and careful observation of the field performance of this equipment has made it possible to work out the small changes and refinements usually necessary on newly designed machinery.

Waukesha Motor Company Adopts Novel Means of Advertising Product

BELIEVING in the strong appeal of the finished product to the prospective buyer, the Oil Industry Equipment Division of the Waukesha Motor Company has initiated an extended advertising and sales campaign which will cover the oil fields of the United States.

The splendid success of a new design of cable tool drilling unit has prompted the action to familiarize the oil

fraternity, made up of producers and contractors, with this usual means of supplanting the old steam engine and single-cylinder gas engine.

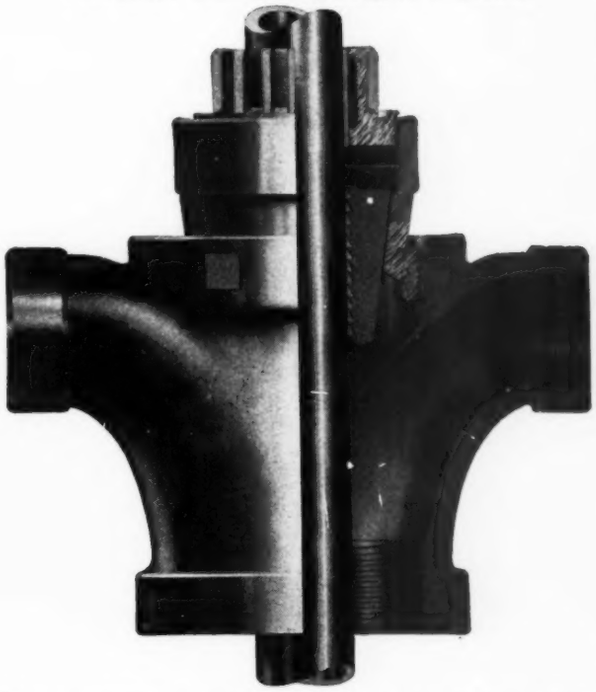
A two-ton Sterling truck, which is also powered by a small Waukesha six-cylinder engine, carries one of the complete units made up of an 85-h. p. hour cylinder engine with reversing transmission. The combination is brightly painted with Waukesha official oil field colors — orange and black. All producing fields will be visited by the truck, in charge of an experienced oil field man, contracting with all dealers selling Waukesha oil field equipment. The engine which is equipped to operate on either natural gas or gasoline as fuel, will be operated during demonstration periods on gasoline and all who are interested in the unit will have the opportunity of operating the controls and studying the performance of this advanced design.

Four sizes of engines are available in the "Type G" design, thus adapting the unit to a wide useful range. Seventy and eighty-five horsepower, four-cylinder engines are furnished for the shallower territories, and one hundred and one hundred twenty horsepower six-cylinder engines for the heavier duty in deep cable tool drilling. All the above engines are adapted to the same reversing transmission which carries a wide factor of safety in meeting the most severe demands of drilling or "fishing" duty.

Features include a weight of only 5,000 pounds, complete with radiator cooling system; transmission with heavy service brake, double outboard pulley for pump and blower; shooting-rell and measuring line clamp and complete control rods with handle. An over-size clutch running in oil, permits severe slipping duty and transmits power through the silent transmission to a Rockwood paper pulley of ample size. Control on the derrick floor is effected by means of a single rod to the transmission with a separate independent pedal on the floor for quick, positive braking action.

The truck will visit all the prominent oil companies in the various oil centers and the itinerary has been drawn up so that all who desire to inspect the unit may do so.

Hercules Has Compact Flow Head



THE Hercules Flow Head, made by the Hercules Tool Company of Tulsa, Okla., was especially designed for air and gas lift. It is simple and compact in design, which makes it easy to install, and, although constructed for flowing wells, it is being used successfully as a casing head after the well is put on the pump, the makers point out. The body (casing head T or Y type) is made of electric steel casting and the top section or packing bowl is made of forged steel, which results in the flow head being an exceptionally strong and serviceable device.

The flow head body has a regular casing head top with set screws so that in case it is desired to run tools into the well an oil saver may be used. In order to do this, the top section (flow head packing bowl) must be unscrewed and removed from the flow head body. If a control head is used while cleaning out, swabbing or agitating, a short nipple can be screwed into the top of the flow head and the control head screwed on to the nipple. The top section is equipped with three slips which support the tubing by gripping completely around it. On top of the slips rest two packing rings which are compressed by a packing nut that screws down into the flow head packing bowl and packs off around the tubing.

The type "A," or Y-shaped flow head, has a 2-inch outlet on the back side so that a pressure gauge may be attached. The type "B," or T-shaped flow head, has two 3-inch, 90-degree side curved outlets.

Bulletin on Electric Motors

SEVEN types of squirrel cage motors are discussed and compared with each other in the new 24-page bulletin 165 issued by Wagner Electric Corporation, under the headings of general purpose, normal-torque across-the-line, low-torque across-the-line, high-torque, double-squirrel cage, punch press and elevator types.

The bulletin is divided into several sections, one discussing the three factors interesting motor buyers (cost, performance and delivery), another analyzes and compares the starting and running characteristics of the various types of squirrel cage motors, and there are other sections devoted to detailed description of construction, ventilation, lubrication, and mechanical diversifications.

(Turn to Page 122, please)

The New Rex Solid Cotter

THE Chain Belt Company has extended the accurate force-fit of Rex Chabelco oil well chain to the last possible point with the new Rex Solid Cotter. This new cotter is not a cotter pin, but a metal piece that fills up the pin hole all the way through, locking the pin securely and permanently into the sidebars. It ends the trouble of flying cotters, and the inconvenience of riveted chain. The accurate force fits—between ground seamless bushings and the special steel sidebars—between ground case-hardened pins and sidebars—the close tolerances—in pitch—between pins and bushings, all combine to give strength which has been known as the Unit Link. Rex Deepwell Chabelco Chain is made in two sizes—the 1030 DW 3, which is an A. P. I.—3 chain, and the 1240 DW 4, which is an A. P. I.—4 chain.

"PETROLEUM Facts and Figures" (second edition), issued by the American Petroleum Institute under the supervision of L. M. Fanning, director of public relations, is one of the most complete compilations of statistics ever published regarding the oil business.

The volume gives the most thorough idea of the production, manufacture, and consumption of petroleum and its products, not only in the United States, but of every country in the oil producing world.

Ideco Purchases Boykin Machinery and Supply Company

ANNOUNCEMENT has just been made of the purchase of the Boykin Machinery and Supply Company of Beaumont, Texas, by The International Derrick & Equipment Company of Columbus and Los Angeles. This acquisition constitutes one of the largest mergers of recent years in the oil well supply industry and marks a further step in the world-wide expansion program of Ideco. The International Derrick & Equipment Company has purchased all of the capital stock of the Boykin Company together with its field stocks and large manufacturing plant at Beaumont, all of which has been transeferred to the Ideco interests.

The Boykin Company has been reorganized as a subsidiary company under the name of The International Derrick & Equipment Company of Texas, with Harry M. Runkle of Columbus, Ohio, as president, B. Boykin, Jr., of Beaumont, Texas, vice-president and general manager, and L. L. Powell of Houston, Texas, secretary and treasurer.

Messrs. B. Boykin, Jr., and E. L. Boykin, both of Beaumont, will continue with the organization in managerial capacities and practically all of the present employes in the office and shops will be retained. A new office building is being erected, a steel foundry installed and a number of new buildings added to the present plant.

International also owns the Houston Galvanizing and Plating Company of Houston. Ten acres of ground have been purchased near the ship canal at Houston, and work started toward the construction of a structural and galvanizing plant at that place for the manufacture of the comp'ete Ideco tower and building line.

The Boykin Machinery & Supply Company has occupied a commanding position as a manufacturer of rotary drilling equipment for a number of years and does a world-wide business. The International Derrick & Equipment Company will maintain the Beaumont and Houston works, adding their production facilities to the other Ideco plants located at Columbus and Delaware, Ohio, Torrance, Calif., and Tulsa, Oklahoma.

International is one of the leading industrial companies in the United States. Its growth under the management of Harry M. Runkle, its principal owner and president, during the past eight years, has been phenomenal. This company has rapidly become one of the leading manufacturers of rust-resisting steel products for the oil, gas, artesian, power and aviation industries.

W. W. Cole of Byron Jackson Co., to Make World Tour of Oil Fields

W. W. COLE, manager of foreign sales for Byron Jackson Co., left recently on an extended trip that will take him into every foreign oil producing country in the world. His itinerary reads like a Cook's tour, but will take him into many places that a Cook's tourist never sees.

W. W. Cole.

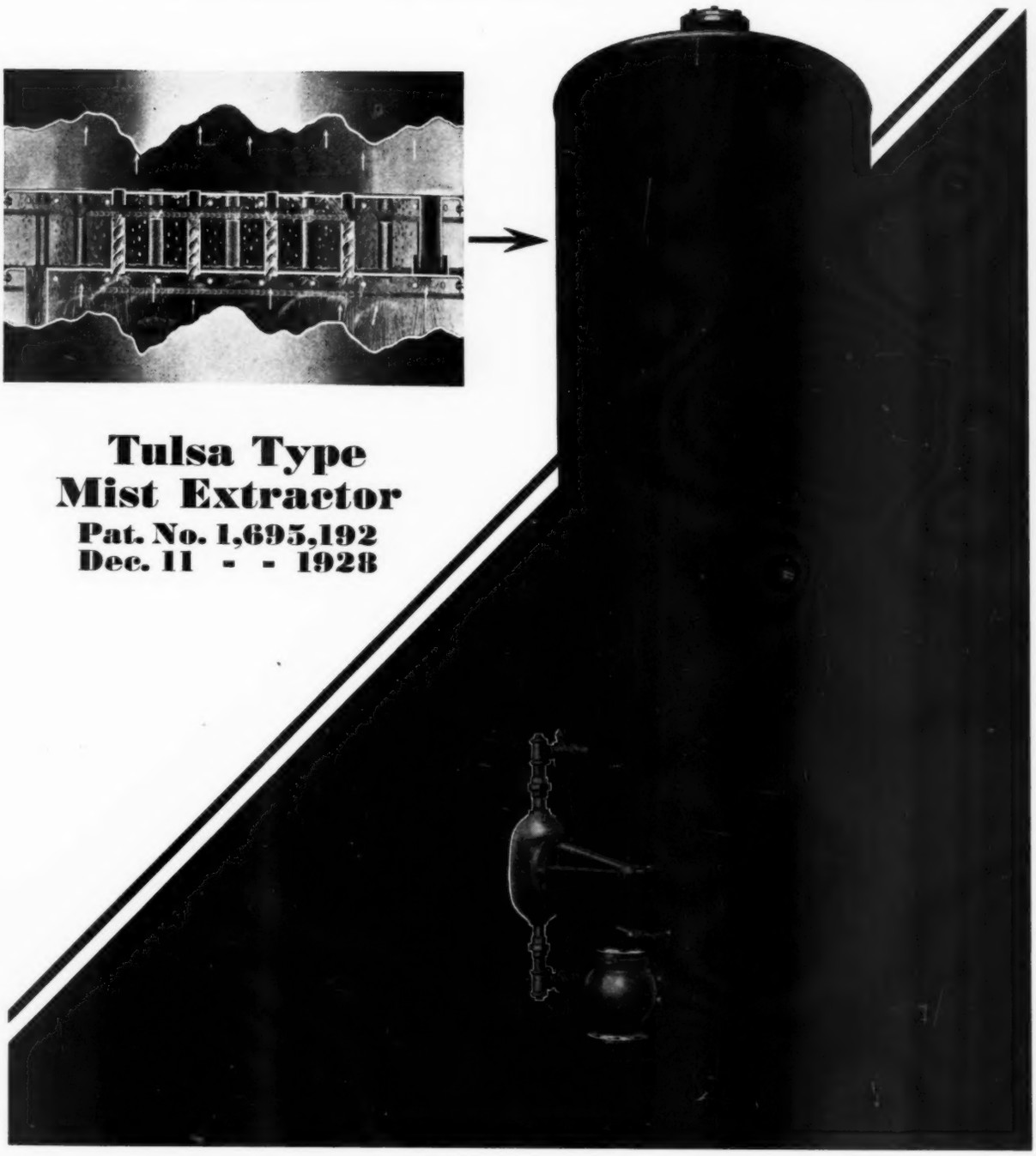
His mission is purely an educational one, it being his intention to study at first hand working conditions, operation facilities and equipment required in each of the countries visited. Executives of the Byron Jackson Co. deem this trip highly essential at this time because since merging of many of the leading oil tool companies under their direction, the combined products of the company now play such an important part in petroleum development throughout the world. Mr. Cole will also inspect the Bettis installations in the various fields. The Bettis rubber is manufactured by the Patterson-Ballagh Corporation, in which the Byron Jackson Co. has substantial interest.

Mr. Cole's acquaintance among men of the oil fraternity is extensive, as he was one of the original organizers of the Craig Oil Tool Company, one of the first companies to participate in the recent Byron Jackson merger.

Mr. Cole sailed on the liner "President Polk" at Los Angeles and went direct to Japan. After a brief stay in Japan, Mr. Cole will proceed to the Straits Settlements, stopping in Singapore. From Singapore he will make a tour of the East Indies, visiting the islands of Borneo, Sumatra and Java. He will then go to Burma, spending a short time in the oil fields of that province. After Burma, Mr. Cole will visit various oil fields in India. Then he will go direct to Irak (Mesopotamia), which he expects to be one of the most interesting and informative visits of his entire trip. In this little country, hemmed in by Persia, Arabia, Syria and Turkey, are located some of the wonder oil fields of the world, where some wells produce as high as 90,000 barrels per day.

Roumania and Russia will next be visited, and from there Mr. Cole will go to the Netherlands, stopping at the Hague in Holland. From there he will then go to London and thence to South America, spending considerable time in the Venezuelan oil fields.

Turn Conversation into
CONSERVATION



Tulsa Type
Mist Extractor
Pat. No. 1,693,192
Dec. 11 - - 1928

CAMP-MORGAN COMPANY

TELEPHONE [redacted] 2-6137
CORNER ARCHER AND DETROIT
TULSA, OKLAHOMA

When writing CAMP-MORGAN COMPANY *please mention The Petroleum Engineer*

Geo. S. Davison

GEORGE S. DAVISON has resigned as vice-president of the Gulf Oil Corp. after twenty-five years' service with that concern. He was in charge of various producing refining and pipe line companies of the corporation. F. A. Leovy has been made vice-president of the Gulf Oil Corp. and president of the Gulf Pipe Line Co., Gulf Production Co. and Gypsy Oil Co. George R. Nutty has been made vice-president of the Gulf Refining Co. Mr. Davison will devote his time to the management of the Davison Coke & Iron Co. of Pittsburgh.

W. H. Geis has resigned as vice-president of the Continental Oil Co. (California) to become president of the Arrowhead Oil Co. of Los Angeles.

R. A. Griffith, president of the Sinclair Oil & Gas Co., is back at his desk in Tulsa after an attack of pneumonia.

L. B. Rowsey, one of the original employees of the Smith Separator Co. of Tulsa, has been made manager of that concern after six years of service, during which time he served as assistant sales manager and assistant to the vice-president.

Bill O'Melia, of Westcott & Greis, Tulsa, Okla., is back on the job minus an appendix which was removed last month.

Lester H. Keim, who was recently elected vice-president of the Oil Well Supply Co., in charge of the company's activities on the Pacific Coast, has been identified with the petroleum industry for many years, and is receiving the congratulations of his friends upon being elevated to the executive family of Oilwell.

C. B. Lynde, for many years with the United Iron Works, has just joined the Struthers-Wells Titusville Corp. as western representative in the refining and natural gasoline plant division. The Struthers-Wells Titusville Corp. is the parent company of the Titusville Iron Works, the Titusville Forge Co. and the Struthers-Wells Co. This concern has just opened offices in the Exchange National Bank Building, Tulsa, Okla., which will be shared by Mr. Lynde and B. F. Kelly, of the production equipment division of the concern.

Lester H. Keim

Jack Ballagh, of the Patterson-Ballagh Corporation of Los Angeles, has covered the principal oil fields at top speed during the past five weeks. He has been using an aeroplane almost exclusively in contacting the various fields. His extensive trip began first with a visit to the Canadian fields, checking up the service of Bettis Protectors. He visited the Wyoming fields en route. He flew from Canada to Portland and returned to Los Angeles for three days and then took a transcontinental transport to Texas for a visit of two weeks. He returned to Los Angeles the latter part of September and plans to fly to Tulsa to attend the Exposition.

R. A. Griffith

Howard F. Weeks has been appointed secretary of the publicity and advertising section of the American Gas Association, according to an announcement by Alexander Forward, managing director of the association. Mr. Weeks was formerly assistant secretary of the section, and since the resignation of Charles W. Person has been acting secretary, as well as editor of the American Gas Association Monthly.

W. H. Geis

Harry Murphy, formerly in the engineering department of the Carter Oil Co., at Seminole, Okla., is now attached to the engineering staff of Humble Oil & Refining Co., Houston.

A. W. Hickman, formerly manager of the Ohio River producing division of the Pure Oil Co., has been transferred to Charleston, W. Va., as production superintendent. He succeeded J. M. Lantz, now superintendent of the Michigan division.

George Casey, formerly assistant to the late George Coyle, general superintendent of the Prairie Pipe Line Co., has joined the sales staff in Tulsa of the Maloney Sales Corp. (tanks). The company recently opened an Oklahoma City branch with A. W. Mahlandt in charge and Henry Dougherty has been appointed to manage the Cleveland (Okla.) branch. The Oklahoma organization is headed by W. H. Elliott.

Following the resignation of W. K. Hughes as chairman of the board of directors of the Continental Supply Co., Frank M. Parnell has been elected to that office. H. Brooks Gutelius, formerly vice-president and general manager, has been made president of the company.

L. B. Rowsey

M. A. Finney, formerly Panhandle district superintendent of the Pure Oil Co., with Pampa headquarters, has been transferred to the Howard county, West Texas, territory. He will make his headquarters at Odessa. J. F. Maritt takes Mr. Finney's place in the Panhandle.

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Kenneth D. Pardee has been appointed district superintendent of the Montana district of the Texas Production Company, with headquarters at Conrad. Mr. Pardee was with the Turkish Petroleum Company for the past three years as field superintendent in Iraq.

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C. O. DeVerse, district superintendent of the Indian Territory Illuminating Oil Company in the Seminole field, has been made assistant to W. P. Sutton, production superintendent for southern Oklahoma, and John Lawry, farm boss at Oklahoma City, has been sent to Seminole to succeed DeVerse.

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R. C. Poore, plant foreman of the air-lift department of the I. T. I. O. in the Seminole field for two years, has sailed for Russia to direct air-lift installations for the Russian government's oil fields.

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The Dixie Oil Company is anxiously waiting on the early completion of the Philcade building in Tulsa, so it can remove the balance of its executive, financial and other offices from Shreveport, La.

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A. W. Peake, president of the Dixie, has already moved to Tulsa and is directing the affairs of this major concern, the Mid-Continent subsidiary of Standard of Indiana. F. O. Prior, a vice-president, has also moved to Tulsa.

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F. J. Schaefer, general manager of the Southern California Gas Company, Los Angeles, has recently returned from an extensive trip to Europe. While there, Mr. Schaefer visited the Berlin Gas and Water Exposition.

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George L. Ratcliffe resigned his position as manager of the General Petroleum Corporation's natural gas department to become president of the California Talc Company of Los Angeles, Calif. His former position has been filled by R. C. Wheeler, former general superintendent of General Petroleum Corporation.

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Major T. J. Strickler, vice-president and general manager of the Kansas City Gas Company, and Miss Margaret Armstrong, of Kansas City, were married in Chicago last month.

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D. A. Locke has resigned from the pipe line department of the Natural Gas Corporation of El Dorado, Ark., to become general superintendent of pipe lines of the Old Dutch Refining Company, at Muskegon, Michigan.

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Alfred Hurlburt has associated himself with Southern Cities Public Service Company at Atlanta, Ga., as consulting engineer.

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S. R. Kimberly has been appointed engineer in charge of all metallurgical work, laboratories, and the test room of the Axelson Machine Company of Los Angeles, succeeding William Laury, recently resigned. For the previous two years, Mr. Kimberly has been working as assistant to Mr. Laury. He is a graduate of Rensselaer Polytechnic Institute of Troy, New York, and for five years had charge of similar research work with the International Harvester Company.

L. J. King, vice-president in charge of production for the Associated Oil Company in California and with the Associated for 27 years, has resigned his position. J. H. Jenkins, who was formerly with the Tidewater organization in Texas, becomes general manager of production and J. A. Jones will be manager of production under Mr. Jenkins. Joseph Jensen has been made the company's chief petroleum engineer.

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R. E. Young has joined the Reading Iron Co. as a sales representative out of the Tulsa office, covering Kansas, Oklahoma and North Central and Western Texas in the interests of Reading wrought iron tubular goods. From 1914 to 1918 Mr. Young covered various districts of Oklahoma and Texas as a scout for the Cosden company. From 1918 to 1920 he supervised wildcatting interests in West Texas, and in 1922 he was with the Pierce Petroleum Corp. in the same capacity.

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Randall McKown, Los Angeles, who has been in the engineering department of the Axelson Machine Company for six years, has just been appointed assistant to A. G. Haglund, works manager, and will have charge of checking production costs and facilitating manufacturing processes and delivery of finished products.

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After twenty-one years of service, Ralph J. Reed, chief engineer of the Union Oil Co., has handed in his resignation, which was effective August 31.

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Amerada Petroleum Corp. is now represented on the Pacific Coast by H. E. McCullough. No office has been opened to date. Mr. McCullough has been living in Long Beach, but has just moved to Los Angeles.

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Abbott Jenks, general superintendent of the Rio Grande Oil Co., Los Angeles, has resigned, and G. B. Watson, in charge of Rio's Elwood district, has been named his successor.

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Wm. McMurray has resigned from the Continental Oil Co. of California. Mr. McMurray, under the Marland regime, was vice-president in charge of all its California production.

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After spending seven and one-half years in the gas department of the Shell Petroleum Corporation, C. J. Fowlston has resigned to take charge of the compressor stations and gasoline plants of the Kansas Gas Pipe Line Company, with headquarters at McPherson, Kan. He will be associated with E. R. Durree, general manager, and Harry R. Maxon, chief consulting engineer, both of Salina, Kan.

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Chase Sutton, formerly chief engineer of the southwestern production division of the Pure Oil Company, has been made district manager of the new Gulf Coast division at Houston, and Earl Carr, his assistant, has been made engineer in charge of the southwestern division at Tulsa.

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Lew Klein, formerly vice-president of the Continental Well Supply Co., Inc., at New York, is now vice-president of the American Steel Export Co. in the metropolis.

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J. L. Penney, sales manager of the Lucey Products Corporation, Tulsa, Okla., accompanied by Mrs. Penney and his father and mother, Captain and Mrs. Fred H. Penney of Haverstraw, New York, is on a combined business and pleasure trip motoring through the oil fields of California.

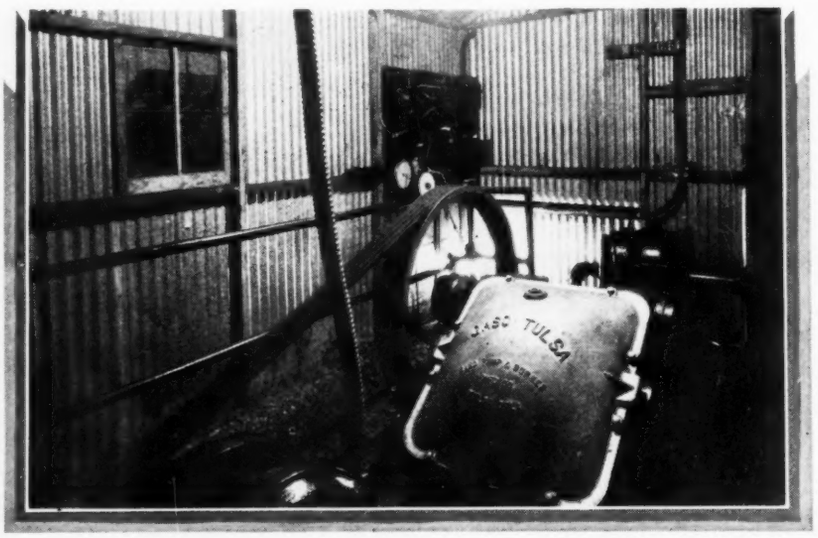
A PIPE LINE BOOSTER *Station*

Operating by Automatic Control

WORKING toward the reduction of relatively high oil losses at a minimum cost on a section of its system near Drumright, Okla., the pipe line department of the Shaffer Oil Refining Co., solved its problem with an automatic controlled booster station which materially reduced operating pressures. A low initial cost was represented in the investment and operating costs were cut materially.

Prior to building the automatic station two delivery lines converged at Drumright into a 10-mile, 4-inch line terminating at Cushing. The maximum distance pumped through one of the delivery lines and on to Cushing was approximately 35 miles. A 4-inch line extended from the Shamrock district to Drumright and a 3-inch handled the oil from Manford and Oilton districts. Both lines had 2-inch laterals.

A steam plant had been in operation at Drumright, but was discontinued when a more direct line was built to Cushing, leaving only around 50,000 barrels per month to be handled at Drumright. The field pumps were then used to pump on through to Cushing. The pumps on the lateral lines worked with varying pressures, sometimes running up as high as 600 pounds. Consequently the pumps were bucking one another.



Gaso pump connected by Tex-Rope drive to Allis-Chalmers motor, and controlled by Bristol equipment on the Shaffer Oil & Refining Co.'s pipe line system in Oklahoma.

Upon installing the automatic controlled station the maximum pressure on the field lines was reduced to 150 pounds. Operation costs also fell with the reduction in pressure through less repairs to field pumps, line breaks and savings in fuel for field pumps. The largest item was the cutting of oil losses. Even during the summer months these losses were slightly under three per cent.

When the automatic station was constructed, the two field lines were cut into a 5,000-barrel working tank. Station equipment consisted of a type 1508 Gaso gear enclosed pump, with a rated capacity of 92 barrels per hour, connected by Tex-Rope drive to a 440-volt squirrel cage, roller-bearing Allis-Chalmers motor.

Automatic control equipment is comprised primarily of a Bristol pressure controller, model 77, using a maximum current of one-half amp., 220 volts and 50 watts, and operates from zero to 25 feet. The transformer is a 440/110-volt transformer for lighting and control currents and the automatic starter is a Cutler-Hammer AC with thermal overload.

The pressure controller was calibrated to feet of oil in the working tank and incidentally can serve as an automatic gauge. It is set to operate when the tank fills two feet six inches with oil. At that level the controller trips the starter which starts the motor. When the oil level is pumped down to one foot six inches, it automatically cuts off the motor. The station operates with an average line pressure of 110 pounds.

While an operator is not required for the station, the district gauger makes a daily visit to change the pressure recording charts. While there, he gauges the working tank with a steel line to make certain the pressure controller is functioning properly. He also cares for the periodical lubrication of the machinery.

To prevent oil from getting into the small mechanism and possibly depositing paraffin on the working parts of the controller, an air chamber has been installed just ahead of the controller. It is a 3-inch cylinder 18 inches long which also serves as a cushion and helps to flatten the pulsation curve.

Since the original station was something of an experiment, only the minimum of equipment was installed. Recently a protective relay was put in for station protection against line plugging or line breaks. It consists of three relays.

In event of either of the described troubles, the first relay closes the circuit to the tripping relay which in turn trips the third relay and shuts down the motor. It is so designed that it will ring an alarm bell. The third relay is hand set and the assembly operates only when line pressure reaches a predetermined minimum or maximum operation setting. After the emergency the motor cannot be started until the protective relay has been reset.

Approximately 1,850 barrels daily are being pumped by this station at present. During the nine months the station has been in operation it has effected a savings in oil losses and operation costs that almost offset the initial investment.

Naylor Pipe Company, Chicago, Ill., manufacturers of the Naylor Line Pipe, announce the opening of a new sales office at 601-3 Post-Dispatch Building, Houston, Texas, and the appointment of E. C. Kirby as district sales manager in Texas and Louisiana, with headquarters at the new Houston office.

Mr. Kirby is exceptionally well known to the oil industry.

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The "BJ" *Weldless* Link—drop-forged from billets of a special chrome nickel alloy steel, scientifically heat treated and drawn to size—fills a long-felt and serious need.

Failure of welded links is nearly always caused by parting of the welds, often resulting in loss of life, as well as causing expensive fishing jobs and other damage. The "BJ" *Weldless* Link completely does away with the heretofore ever-present danger in the use of welded links.

Our contribution of this important improvement toward added safety to life and property is extremely gratifying to us.

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"Problems *and* Progress *in the* Protection *of* Pipelines Against Corrosion"

DR. GORDON H. SCOTT, *A. P. I. Research Associate with U. S. Bureau of Standards*

THE widespread interest in problems of corrosion in the petroleum industry found early expression in group sessions at the annual meetings of the Institute and culminated in the formation of a general committee on corrosion.

The *modus operandi* of this committee in the early months of its existence was not well defined, but its purpose was specific. Two logical subdivisions in the general committee segregated the problems into those appertaining to refinery and marine corrosion, and those allied to pipe line and production corrosion. The specific purpose—namely, the reduction of the enormous annual toll exacted by corrosion and enlarged by wasteful methods of combatting corrosion—could best be carried out as a start by canvassing the industry for its experience and correlating the information thus gained.

To this end two important steps were taken. In the first place, a corrosion record form, quite general in character and yet applicable to all phases of corrosion, was drafted and circulated for the purpose of assembling existing knowledge of corrosion as it occurs in the industry and of the methods which have been employed to combat it. The corrosion committee was of necessity limited in its membership, but the appointment of contact representatives from organizations engaged in producing, transporting or refining petroleum products served to enlarge the sphere of the corrosion committee's activities. The first active function of these contact representatives was, thus, supplying the corrosion committee with such information on corrosion with respect to the existence, severity and combative measures used as fell within the realm of their experience. More recently regional contact conferences have been arranged for the dual purpose of bringing recent developments to the attention of these contact representatives, and to afford the opportunity for an intimate exchange of ideas. In the second place, a full-time field investigator was employed and assigned as a research associate at the National Bureau of Standards to take part in the work of the Bureau of Standards on corrosion and to aid the Corrosion Committee in its work.

It became clear in the early stages of the first field investigation of the research associate that the scope of the Corrosion Committee's activities was entirely too large for a single investigator, and, since the prospects of speedily accomplishing something definite were greater in the case of pipe line corrosion, the research associate's activities were restricted to that phase of the problem. The work has, therefore, been closely associated with that of a Subcommittee on Production and Pipe Line Corrosion of the General Committee.

A large part of the preliminary work consisted of the critical examination of existing coatings on pipe lines with the general purpose of defining the status of pipe line coating practice. Two important developments resulted from this early work. It appeared, in the first place, that in many instances methods of application were both inefficient and wasteful. In the second place, the primary cause of the failure of a large part of the coatings commonly used was identified with soil action in its various ramifications.

With the aid of the members of the Subcommittee on Production and Pipe Line Corrosion and the manufacturers involved, existing knowledge pertaining to the proper methods of application of hot bituminous coatings was collected, assimilated and formulated into a good-practice statement.[1]

Numerous questions have arisen as a result of the observation of the disrupting effect of soil action on coatings to which the data of the preliminary work could not supply an answer. The geographical extent and importance of soil action; its relation to soil texture, topography and drainage; and the efficacy of the numerous and diversified coatings in withstanding the disruptive effects of the soil, were questions to which, it appeared, field inspections could supply an answer.

Field inspections of protective coatings in pipe lines, while serving a very useful purpose, leave much to be desired in the way of accurate data. The variables affecting the behavior of protective coatings are large in number and complicate the interpretation of field-accumulated information. Even in practical coating tests, many of the variables cannot be controlled. The American Gas Association has instigated coated-nipple tests and these are being conducted by the Bureau of Standards through the research associate of the American Gas Association. The purpose of these tests is to compare under a variety of known soil conditions the behavior of a number of practical and proprietary coatings and to obtain basic information which will be of value in devising dependable experimental methods for predicating the behavior of coatings. The uncertainties as to methods of application and material specifications in existing line treatments restricted the value of observations on them for the purposes described above. On the other hand, there is immediately available on existing lines a wealth of information regarding the practical aspects of coating performances. For example, a knowledge of the probable behavior of a given practical field-applied coating under various actual service conditions cannot be more adequately nor speedily obtained than from systematic and regular inspections of that coating in a specified manner. Statistically, field inspections constitute a powerful and convincing source of practical information.

It is generally conceded among competent observers that at present a coating's worth can only be determined from its actual performance under service conditions. Numerous factors are encountered on operating lines which are not met with in buried nipples. Coating tests on operating lines have been proposed by the Subcommittee on Production and Pipe Line Corrosion. The so-called "three-cornered tests," in which it is proposed that the Bureau of Standards join with the manufacturers and consumers, have met with considerable favorable comment in the industry,

*Presented before the Fall meeting of the Texas-Louisiana-Arkansas district of the A. P. I., Division of Development and Production Engineering, at Galveston, Texas, Sept. 5 and 6, 1929.

[1] A. P. I. Code of Good Practice in the Application of Protective Coatings to Underground Pipe Lines—Tentative Code No. 1—The Field Application of Hot Bituminous Coatings.

(Turn to Page 166, please)

Before you strike pay sand

When the going to tough—
tools — the driller in a
tough formation — every
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Why not see that your tools
rock abrasions before the
ASCO Steel will hold tem
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ASCO Steel for your next
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sweating roughnecks pulling
fury to make headway thru a
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the men settles down to nor-
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will stand the gaff of tough
same thing happens to you?
per under the most severe
bit will continue to oper-
must be pulled and dressed.
drilling costs and drilling
ment—is minimized. Specify
lot of drilling tools—keep
results—there is a difference.

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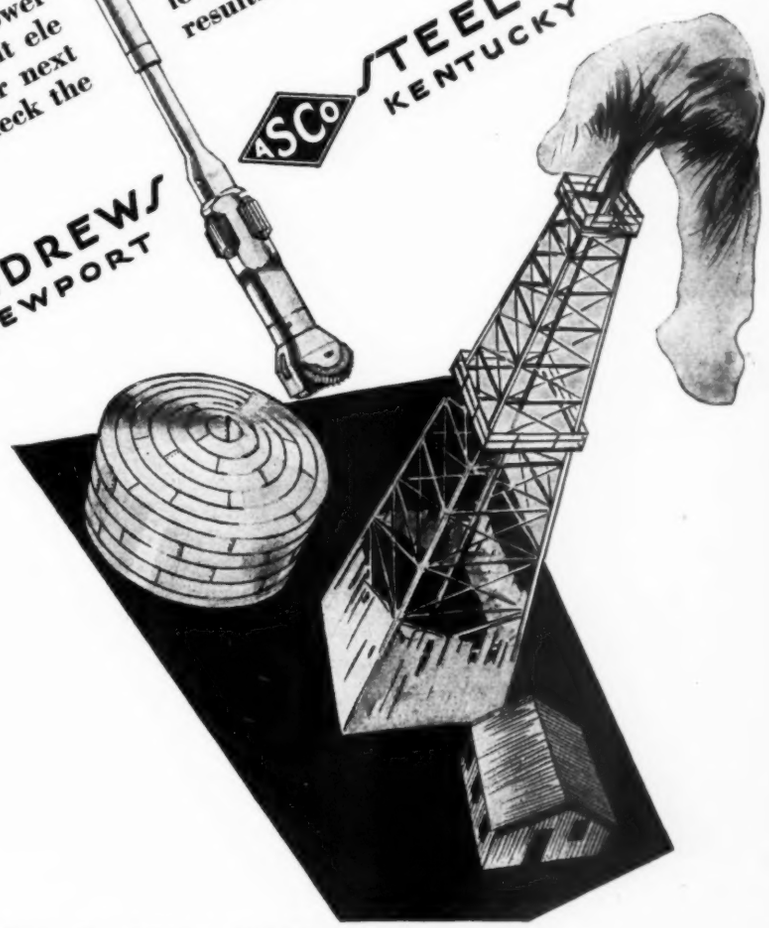

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however, each important user of coatings would study its own coatings critically and all could bring their results together following either the scheme suggested above or some other plan, the economic benefits ought to be large and immediate.

Discussion of Dr. Scott's Paper

Accompanying the showing of slides on screen Dr. Scott brought out some important points on corrosion.

Soil stress effect on pipe coatings has been studied in detail in the field. Settling of the soil in trenches distorts the coating on top side of pipe. Seldom is there a uniform distribution of support by the soil on the under side of pipe. Photographs taken in the field were shown as supporting evidence of this condition.

One of the real functions of tar paper and other similar coatings is to prevent any sharp points of penetration by pebbles or such in the soil. A coating to be fully effective should be continuous.

Corrosion taking place under the coating often cannot be accounted for. It is due neither to the coating itself, the pipe, nor to improper methods of applying the coating.

E. S. Durward of the Shell Corporation, Dallas, Texas, cited an example of eliminating incrustation in a water line in California field by giving the pipe a thorough treatment under temperature in hot tar. Prior to this treatment it was necessary to run a go-devil at frequent intervals to keep the inside free of incrustations. After the hot tar treatment the trouble disappeared.

Comments on the use of sand blasting surfaces of metal preparatory to applying protective coating brought forth an opinion that only in exceptional cases was the cost to do so justified. Costs of sand blasting the interior surfaces of tanks run about 1c per square foot.

One member present agreed with Dr. Scott's conclusions regarding the indiscriminate use of pipe coatings. He went even further in his statement by saying that it was cheaper to suffer losses by corrosion than to go to the expense of applying protective coatings to pipe indiscriminately. Three important considerations entered into the problem: first, determine whether or not the cost of a coating is justified; second, selection of the proper coating; third, the method of applying the coating. Emphasis was placed on the selection of the proper coating.

There was disagreement with the opinion expressed in regard to the indiscriminate use of coatings. In the opinion of Mr. Hull, president of the Texas Pipe Line Company, there are great losses both in capital investment and loss of time and oil due to lack of care and treatment to lines. Of greatest importance in cutting down losses due to corrosion is timely attention and renewal of pipe. Mr. Hull stressed exercising care in applying coatings. Surfaces should be properly prepared by removing all moisture, oxides and other deleterious matter. Regardless of whether or not the coating applied is the proper one to use, it usually is more economical to apply a coating than to neglect doing so entirely.

Mr. Durward of the Shell Corporation, Dallas, Texas, brought up the question of aluminum paints being more effective than other types as a coating because of a protective coating that is formed by chemical action. This apparent advantage of aluminum paint coatings was observed particularly in West Texas.

In the general discussion that followed, the importance of proper methods of applying coatings was emphasized. No matter how good a coating was used, it could be rendered practically useless by improper applications.

It was reported that an important test has just been started on a 55,000-barrel tank in West Texas. The outside of the tank is coated with aluminum foil. The foil keeps the tank relatively cooler than without the foil and in this way assists in cutting down corrosion inside the tank. Coating the inside of the tank with aluminum foil is also to be tried. Two thicknesses of foil have been used, .002-in. and .003-in. and the cost is about $2.05 and $2.55 per 100 square feet respectively. It comes in rolls and is applied to the metal with an adhesive paint, similar to applying wallpaper. With one man applying the adhesive paint and another rolling on the foil, the cost of application is about the same as applying two coats of paint.

"Methods *of* Waste Water Disposal"---

S. W. OBERG, *Humble Oil and Refining Co., Houston, Texas*

THE disposal of salt water in the oil fields of Texas has become a matter of concern as a result of the statutes governing streams and underground water pollution. Local conditions govern the method that must be used to get the most economical results. The methods used are: (1) Cavity wells, (2) Direct run-off to streams and the sea, (3) Seepage into the ground and evaporation, (4) Storage during dry periods and run-off to streams during floods.

Cavity wells are used extensively in salt water disposal in the Gulf Coast fields. This method has been used successfully at Liberty, Dayton, Hull and Damon Mound for a number of years. The usual practice is to collect the water in earthen pits and pump it to the cavity wells which are located on top of the salt domes. This method has been recently successfully applied in the Hendrick Field, Winkler County, in West Texas, where the wells are drilled to the top of the Barstow sandstone, at which point casing is cemented to prevent the pollution of upper fresh water sands. Some of these wells are reported to take as high as 40,000 barrels daily, with pressures ranging from zero to 75 pounds. The depths of the wells are from 305 feet to about 1,600 feet.

Due to their geographical location, direct run-off to the sea is used at Goose Creek and West Columbia. Run-off to rivers is used in the Powell, Mexia and Luling fields and, for the present, in the Salt Flat field. The Powell Salt Water Company was organized in the Powell Field. Right-of-ways were purchased across private lands and down Chambers and Richland creeks to the Trinity River for disposal of salt water. Several lawsuits have been brought against the company, claiming damage to lands adjoining creeks, which so far have been successfully defended. In the Luling field, water is ditched to several creeks and flows down these to the San Marcos River. The same method is in use in the Salt Flat field, but steps are being taken to store the salt water during dry periods and allow it to escape during high water periods in order to reduce the salinity in the San Marcos and Guadalupe Rivers. At Breckenridge

Turn to Page 168 Please

*Presented before the Fall meeting of the Texas-Louisiana-Arkansas district, A. P. I. Division of Development and Production Engineering at Galveston, Texas, Sept. 5 and 6, 1929.

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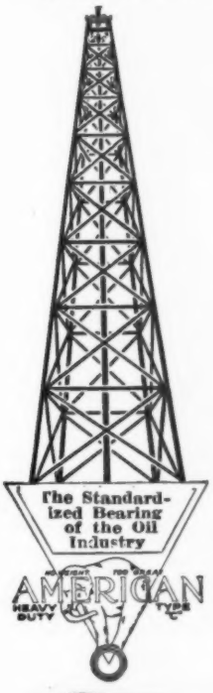
HEAVY DUTY TYPE "C" INDUSTRIAL
ROLLER BEARINGS

Oil Field Crown Blocks



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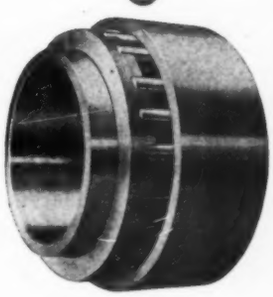
For the most advanced Traveling and Crown Blocks, an ease of operating over a period of years unknown in the use of plain bearings, is assured by using American Heavy Duty Roller Bearings.



Pacific Coast Representatives

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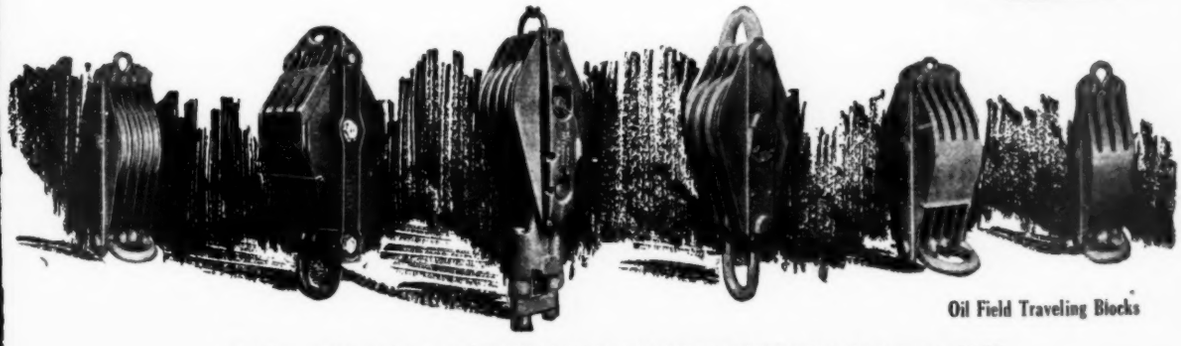
Edward D. Maltby Co., 321 W. Pico St. Los Angeles, California



Oil Field Traveling Blocks

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most of the salt water escapes into the Gonzales Creek, then down to the Clear Fork of the Brazos River. Gonzales Creek is generally recognized as a salt water creek through the Breckenridge field. At Vernon, the Wilbarger Salt Water Company was formed to pump water to the Pease River, a brackish water stream. Water is delivered to a gathering pit at the water company's pump station by the various operators, where it is metered, and each operator charged a fixed rate per barrel prorated by the disposal company.

Seepage and evaporation can be utilized in most parts of Texas excepting the East Texas and Gulf Coast territories, where the rainfall is equal to, or exceeds, evaporation. Seepage and evaporation pits have been successfully used at Cisco, Wichita Falls and West Texas. Strictly speaking, evaporation pits probably lose more water by seepage than by evaporation. In the Wichita Falls, Cisco and San Antonio areas the evaporation is such that approximately 800 square feet of surface is required to evaporate one barrel of salt water per day throughout the year. In West Texas, where the evaporation is greater, about 650 square feet of surface is required to evaporate one barrel per day. In the San Antonio area an earthen tank covering 100 acres would evaporate about 1,960,000 barrels of salt water during a year. While it is desirable to have pits on a porous soil, pollution of domestic water wells will result if care is not exercised in selecting sites. Pits have been abandoned in several instances because seepage had polluted underground fresh water supplies. According to analysis of water at Cisco, Breckenridge and Wichita Falls, about 7½ tons, or 118 cubic feet, of salt, or solid matter, will be produced in one year by the evaporation of one barrel of salt water per day. This amount of salt may cause trouble in time. To get the maximum efficiency from evaporation pits they should be shallow and the bottoms as level as possible. If the ground is not level, pits may be built one above the other, or terraced, as a series of shallow pits are better than one deep pit.

Storage during low-water periods and run-off during high-water periods is being used at Orange and Sour Lake. This method is also used in the Wichita Falls and Breckenridge districts, where water is released from storage pits during periods of heavy rainfall. The Orange Salt Water Company was formed at Orange oil field and water is delivered by the operators to a gathering pit. A water system of proper pumps and a cast iron pipe line was installed. The salt water is pumped to a reservoir covering approximately 160 acres in a marsh south of the Orange oil field. Water is released from this reservoir during high-water periods. It has been necessary to enlarge this system, because the amount of water being produced exceeded estimates made when the system was first installed.

The Hardin County Salt Water Company was organized at Sour Lake and is now operating under an injunction. This injunction was obtained by rice-growers who are taking water out of Pine Island Bayou and the Neches River and who claimed that salt water from the Sour Lake field was destroying their crops. The salt water is delivered to three different reservoirs and allowed to run down Pine Island Bayou during such time as the court designates. The levees of the reservoir at Sour Lake are inspected daily by the Hardin County Salt Water Company and at intervals by a representative of the Jefferson County Court. Samples of water are taken from Pine Island Bayou regularly by the Hardin County Salt Water Company for their protection in the event suits should be filed against them.

At Raccoon Bend a cast iron pipe line has been built from the collection pits in the field to an earthen reservoir covering approximately 100 acres. Salt water is stored in this reservoir during rice irrigating seasons and allowed to escape therefrom into the Brazos River only during high-water periods.

In all fields where salt water is handled, a cast iron pipe line is used, due to the corrosive action of the salt water. Centrifugal pumps, which are generally used for pumping salt water, should be either of all iron or all bronze, as electrolytic action will soon destroy them if made partly of iron and partly of bronze or steel.

In fields where salt water is allowed to run directly into the streams or sea, or when it is stored during dry periods and allowed to run into streams during floods, great care must be taken that stream pollution from waste oil does not occur. The Federal Government is now taking steps to curtail pollution of navigable waters and it is necessary that water pass through a skimming plant in order to remove all waste oil. When salt water is run directly into streams, complaints from pollution will be greatly reduced if suitable skimming plants are installed and all waste oil or B. S. is removed, as the average layman, upon seeing oil on a stream, will jump to the conclusion that it is also polluted with salt water when there may not be any salt water entering it.

Discussion of Oberg Paper

FIELDS (Shell Co.): In California, water was disposed of by pumping into wells. This method was not successful, due to the face of the sand into which the water was being pumped "liming up." When pumping started, the pressure required was only 135 pounds and increased in a short time to 500 pounds, thus making the cost of water disposal by this method prohibitive.

(EDITOR'S NOTE: Information on the Sand Springs (Okla.) plant might be useful, as it may be possible to work out an economical method of extracting the salts, thus rendering the water free from pollution features and at the same time establish a source of revenue from by-products.)

K. H. Burton

R. D. Hardcastle

Resistcor Sales Officials

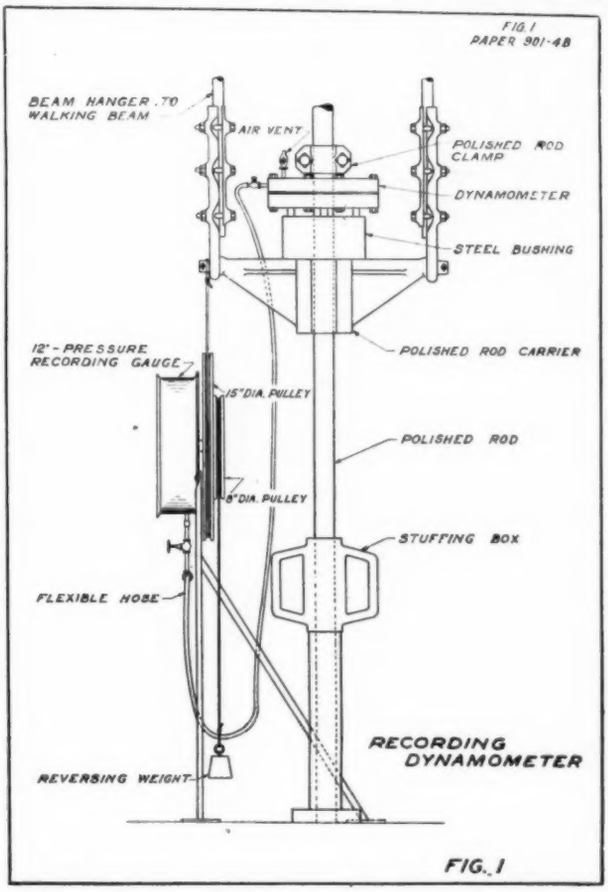
Resistcor Engineering Corporation, has as its sales manager, K. H. Burton, who is widely known thruout the Mid-Continent field. Mr. Burton is thoroughly familiar with all phases of the coating business having more or less pioneered the present application of underground coatings. The proper application of coatings is one of the high points in the sales and service department of Resistcor.

R. D. Hardcastle, manager of southern division of Resistcor Engineering Corp., with offices at Houston, Texas, has been actively engaged in the selling of underground protective coating for a number of years. He is thoroughly familiar with coating problems in that territory.

Weighing and Counterbalancing Wells*

By W. C. SHUTTS,
Petroleum Engineer and B. L. MOORE, Electrical Engineer, Humble Oil & Refining Co., Houston, Texas

A RECORDING dynamometer was constructed as illustrated in Figure 1. This dynamometer was designed by C. V. Temple, Petroleum Engineer, West Texas Division, Humble Oil and Refining Company. The dynamometer is of the hydraulic type and requires no special beam hanger or disturbance of the regular well hook-up. To install it, the dynamometer is slipped down over the polished rod until it rests upon the regular polished rod carrier. A polished rod clamp is then installed on top of the instrument and the full weight of the rods is allowed to rest upon the dynamometer. The weight of the rods is carried by four pins which act upon a diaphragm, imparting the load to the fluid above. The pressure of the fluid is transmitted by means of a flexible hose to the recording pressure gauge. The major part of the recording apparatus is a 12-inch static recording case with pressure element, two light wood pulleys to revolve the chart, and a light tripod, made of ½-inch pipe, that can be dismantled easily. A pressure recording chart is used for taking indicator cards, and the revolving mechanism is so constructed that any travel of the polished rod can be read direct from the card in inches. The pressure of each part of pumping stroke is recorded and a circular card is obtained. The circular card can be replotted on cross-section paper for office files and study. The indicator chart is actuated by the movement of the polished rod on the upstroke, and a reversing weight on the downstroke. When so desired, the chart can be set to retrace itself for several strokes and an average card for these several strokes is obtained. The working cross-sectional area of the dynamometer is such that for each pound pressure registered on the indicator chart, a load of 25.8 pounds is acting on the dynamometer.



The information obtained with this instrument has been indispensable in analyzing existing pumping conditions and arriving at the conclusions given in this paper.

Due to a large amount of sucker rod trouble in comparatively easy wells, 40 wells have been weighed under various conditions. These wells vary from 2250 feet to 2700 feet in depth. Ten of the wells weighed are equipped with standard pumping rigs and grasshopper counterbalances. The remainder of the wells weighed are equipped with reduction gear units with rotary or grasshopper type counterbalances. Normal pumping speeds vary from 17 to 31 strokes per minute. Tests were made at pumping speeds ranging from 14 to 34 strokes per minute. Gas engines and electric motors are used as prime movers. Indicator cards have been plotted for representative wells to show existing pumping conditions as determined by the dynamometer.

Means of Evaluating Sucker Rod Service

The present system of evaluating sucker rod service on the number of days run, or barrels of fluid lifted, has proven inadequate in that in a number of cases rods operating in supposedly easy wells have given very poor service, while the same make of rods operating in supposedly hard wells have given no trouble. Rods have been condemned and junked for failure to give satisfactory service in wells that were pumping little fluid and thought to be easy wells, but on weighing the wells the rods were found to be heavily stressed and doing a great deal of work. Through the use of the dynamometer, a method has been developed for actually measuring the work done and evaluating the sucker rod service. The life of a string of rods may be influenced by many factors and to calculate with complete accuracy the exact amount of work performed by a string of rods is an almost impossible task. It has been found, by weighing wells periodically, that the amount of work performed by the rods is fairly uniform as long as the operating conditions—such as length of stroke, strokes per minute, and type and size of equipment—remain constant. By weighing wells periodically, a constant check may be kept of the pumping motion and the sucker rod service obtained by the following formula:

Ton Mile Service

$$= \frac{(U_L \div D_L) N \times L \times 1440 \times S}{5280 \times 2000} \text{—(Formula 1)}$$

Where U_L = Upstroke load.
D_L = Downstroke load.
N = Number strokes per minute.
L = Length of stroke (feet).
S = Days service.

Some of the Causes of Sucker Rod Failure

The well illustrated in Figure 2 was giving considerable rod trouble, a failure occurring every four or five days, either in the body of the rod or in the joint. The well was pumping with a 51-inch stroke. Indicator cards showed the

*Presented before the Fall meeting of the Texas-Louisiana-Arkansas district A. P. I. Division of Development and Production Engineering at Galveston, Texas, Sept. 5 and 6, 1929.

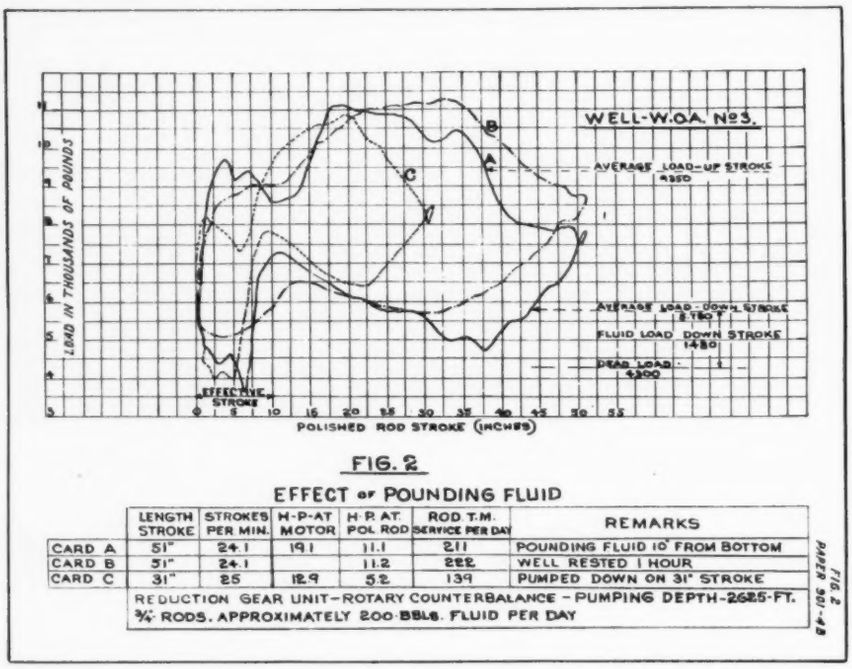


FIG. 2

EFFECT OF POUNDING FLUID

	LENGTH STROKE	STROKES PER MIN.	H-P-AT MOTOR	H.P. AT POL. ROD	ROD T.M. SERVICE PER DAY	REMARKS
CARD A	51"	24.1	19.1	11.1	211	POUNDING FLUID 10' FROM BOTTOM
CARD B	51"	24.1		11.2	222	WELL RESTED 1 HOUR
CARD C	31"	25	12.9	5.2	139	PUMPED DOWN ON 31" STROKE

REDUCTION GEAR UNIT-ROTARY COUNTERBALANCE - PUMPING DEPTH-2625-FT.
¾" RODS. APPROXIMATELY 200-BBLS. FLUID PER DAY

PARKER 501-4-B FIG. 2

plunger to be hitting fluid 10 inches from bottom. (Note the vibratory stresses that are set up in the string of rods when pounding fluid.) The well was shut down for an hour to build up a fluid head. The plunger hit fluid higher up but pumped down to 10 inches from bottom in a short time. Various experiments were tried in lowering and raising the plunger in the barrel, but in each case approximately 10 inches of fluid was lifted. The stroke was reduced to 31 inches, with the plunger hitting fluid at the same position. A large decrease in power consumption, with a corresponding decrease in horsepower at the polished rod and work performed by the sucker rods, was effected, with no loss in effective stroke or production. The decrease in power is not in proportion to the decrease in load at the polished rod, and a lower overall power efficiency is obtained at the lighter loads. Previous to changing the stroke at this well there had been 14 rod failures in 72 days, or one failure every five days. In 88 days' service since weighing the well, there have been six failures, or one failure every 15 days. This well is pumping at 25 strokes per minute with a constant speed motor. It is believed that slowing the pumping motion down to 18 strokes per minute, and lengthening the stroke to take care of the production, should give a very smooth pumping motion and practically eliminate the sucker rod failures.

Several of the heaviest wells weighed, and those causing the most rod failures, are wells making from 100 barrels to 200 barrels of fluid and pounding fluid anywhere from 7 inches to 20 inches from bottom. By weighing these wells, the exact length of effective stroke was determined and the pumping motion regulated accordingly. Sucker rod failures have been reduced to one or two a month, where previous to weighing a failure was occurring every few days. Power consumption at the motor has been reduced 25 to 50 per cent.

Figure 3 shows cards taken on a well pumped at comparatively high pumping speeds. Card "A" was taken at normal pumping speed of 31 strokes per minute and Card "B" was taken at 34 strokes per minute. Note the high maximum and low minimum loads, with a whip or jerk occurring at each end of the stroke. From a study of indicator cards taken, and curves plotted on plunger travel as against polished rod travel, an analysis of Card "A," Figure 3, is as follows: The rods are picked up at the bottom of the stroke at point "A". From point "A" to point "B" the polished rod travels upward with a sharp increase in load, absorbing rod stretch and accelerating the fluid load. From point "B" to point "C" the plunger travel is approximately the same as the polished rod travel. The high peak load occurring at point "D" is resultant impact load and accelerated fluid column load. During this period the plunger travel is a great deal less than the polished rod travel, due to rod stretch. From point "D" to point "E" a deceleration of the rods takes place with a decrease in load. Due to this decrease in load the rods are contracting and the plunger travels upward with a much higher velocity than the polished rod. At point "E" the plunger has decelerated to the same velocity as the polished rod and the two travel together through a fraction of the stroke. From point "F" through point "G," at the top of the polished rod stroke, to point "H" the plunger is lagging behind the polished rod, resulting in an increase in load. At point "F" the plunger reaches its maximum upward travel slightly ahead of the polished rod. From point "F" to point "G" the plunger travels downward slightly while the polished rod is still traveling upward. The increased load from point "G" to point "H" causes the rods to stretch at the same time the polished rod is traveling downward and the movement of the plunger is greater than the polished rod. From point "H" to point "K" a downward acceleration of the rods takes place. At point "H" the polished rod velocity becomes equal to the plunger velocity and the travel of the two is equal. From point "I" to point "J" the rods are accelerated downward with a decreasing load. The rods contract and the plunger travel

Turn to Page 172 Please

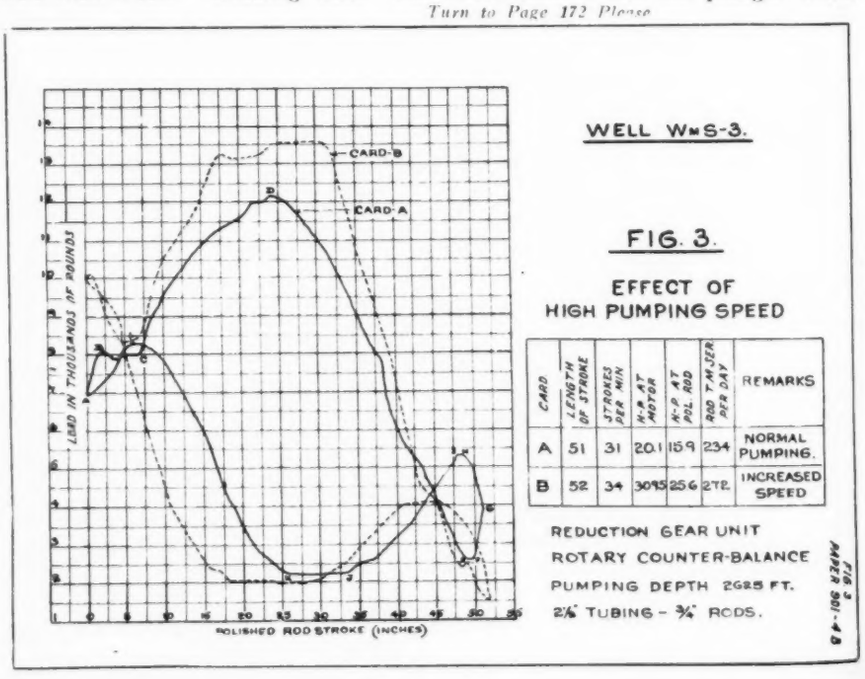


FIG. 3.

EFFECT OF HIGH PUMPING SPEED

CARD	LENGTH OF STROKE	STROKES PER MIN	H-P AT MOTOR	H-P AT POL. ROD	ROD T.M. PER DAY	REMARKS
A	51	31	20.1	15.9	234	NORMAL PUMPING.
B	52	34	30.15	25.6	272	INCREASED SPEED

REDUCTION GEAR UNIT
ROTARY COUNTER-BALANCE
PUMPING DEPTH 2625 FT.
2⅛" TUBING - ¾" RODS.

PARKER 501-4-B FIG. 3

STOODY COMPANY

INTERNATIONAL PETROLEUM EXPOSITION

Welcome!!

to the Stoody Booth at the International Petroleum Exposition.

The *world* has used our products, and *now* we invite the world to meet the boys that make, sell and tell about them

STOODITE . . . STOODY ROD . . . BORIUM . . . Welding Rods for every use . . . STOODY GRINDERS . . . each of this famous family of quality will be on display, *and*, a welcoming "reg'lar guy" will be on hand to tell about them . . . C'mon gang !!! Our booths are located in the Texas Building, Nos. 43, 44, 45. Welcome !!!

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STOODY COMPANY

Manufacturers of WELDING ROD - ALLOY STEEL - EQUIPMENT

Whittier, California

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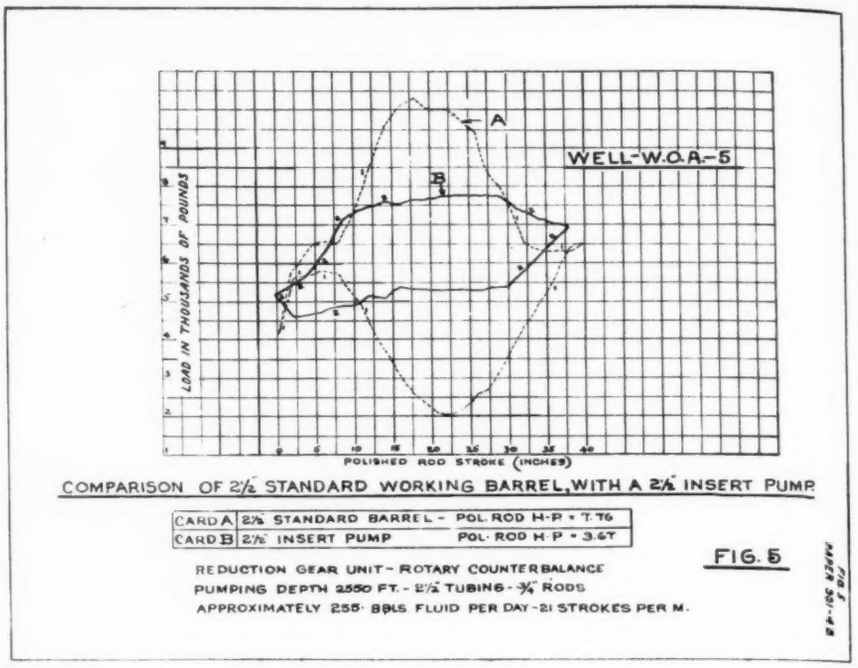
is less than the polished rod travel. At point "J" the polished rod starts decelerating and the velocity and travel of the plunger becomes equal to that of the polished rod. From point "K" to point "L" the rods are decelerated, causing an increase in load. This increase in load causes the rods to stretch on the down stroke, which, added to the polished rod travel, causes a greater plunger than polished rod movement. At point "L" the plunger velocity becomes less than the polished rod velocity and a decrease in load results to point "A" at the bottom of the stroke. The indicator card on this well indicates a much greater plunger movement than polished rod movement. A study of all indicator cards obtained suggests the possibility of the existence of a critical speed at which a pumping well might be operated and a more efficient plunger movement obtained than at either an immediately higher or lower speed. Cards taken at slower pumping speeds show a decrease maximum load and an increased minimum load, with peak loads occurring in about the same position in the stroke. Less differential in rod stress will increase sucker rod life and more efficient counterbalancing can be obtained. The cards show that, with a pumping stroke ranging from 52 inches to 72 inches, the peak load occurs at approximately 45 degrees to 80 degrees of the crank travel, on the upstroke of the rods, but as this stroke is decreased to 24 or 32 inches at the same pumping speed, the peak load occurs near the top of the stroke. With the peak load occurring near the top of the stroke, considerable plunger movement is lost due to stretch in the rods and is not recovered before the rods start their downward travel. On this basis a more efficient pumping motion should be obtained by a longer stroke and slower pumping speed, hence, this would depend to some extent on the pumping depth of the well, as in the deeper wells the impact and accelerated loads would occur later in the pumping stroke.



COMPARISON OF 2½ STANDARD WORKING BARREL, WITH A 2½ INSERT PUMP

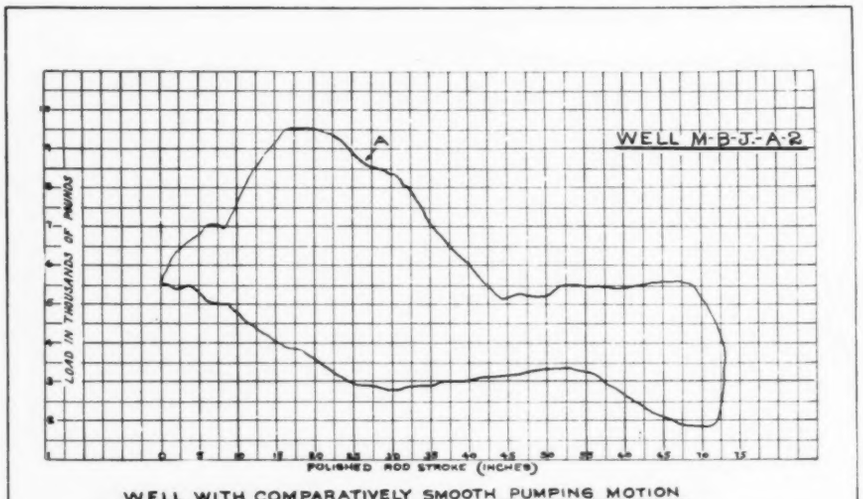
CARD A	2½ STANDARD BARREL -	POL. ROD H·P · 7.76
CARD B	2½ INSERT PUMP	POL. ROD H·P · 3.67

REDUCTION GEAR UNIT - ROTARY COUNTERBALANCE
PUMPING DEPTH 2550 FT. - 2½ TUBING - ¾ RODS
APPROXIMATELY 255 BBLS FLUID PER DAY - 21 STROKES PER M.

FIG. 5

Figure 4 shows a card of a well pumping on a long stroke and handling considerable fluid. This well has a very efficient pumping motion and has given no rod trouble.

Figure 5 shows a comparison between a 2½-inch standard working barrel and a 2½-inch insert pump. Very little rod trouble has been experienced at this well since installation of the insert pump, in comparison with previous rod failures. As the cross-sectional area of the insert pump plunger is approximately 74 per cent of that of the standard barrel, a lighter running pump is to be expected. The reduction in down time, due to an easier running pump, may offset any disadvantage of the smaller capacity. Similar conditions have been obtained by changing from 2½-inch to 2-inch tubing and working barrel.



WELL WITH COMPARATIVELY SMOOTH PUMPING MOTION

CARD	LENGTH STROKE	STROKES PER MIN.	H·P AT MOTOR	H·P AT POL. ROD	ROD T.M. SERVICE % DAY	REMARKS
A	73"	21		12.8	102	NO ROD FAILURES

REDUCTION GEAR UNIT - ROTARY COUNTERBALANCE
PUMPING DEPTH 2650 FT. - 2½ TUBING - ¾ RODS
APPROXIMATELY 800 BBLS. FLUID PER DAY

FIG. 4

Counterbalancing

Counterbalancing is usually considered merely from the standpoint of power saving, but experiments conducted on several pumping wells disclosed the fact that changes in counterbalance weight will not only reduce the load on prime movers but will also smooth out the rod motion, reduce impact loads, and affect the plunger movement.

If a pumping well can be considered as a machine, the well can be balanced, not considering certain factors such as friction, acceleration, gas and others, as follows:

Upstroke of the rods $= Bw + Wp = Fw + Rw$; $Wp = Fw + Rw - Bw$.

Downstroke of the rods $= Bw - Wp = Rw - Wb$; $Wp = Bw - Wb + Rw$.

In a balanced machine Wp will be equal on the upstroke and the downstroke and $Bw = \frac{Rw + Fw - Wb}{2}$ (Formula 2)

Where Bw = Weight of Counterbalance.
Wp = Maximum force at crank end of beam.
Fw = Fluid load supported by valves.
Rw = Weight of rods.
Wb = Buoyant effect of fluid on rods.

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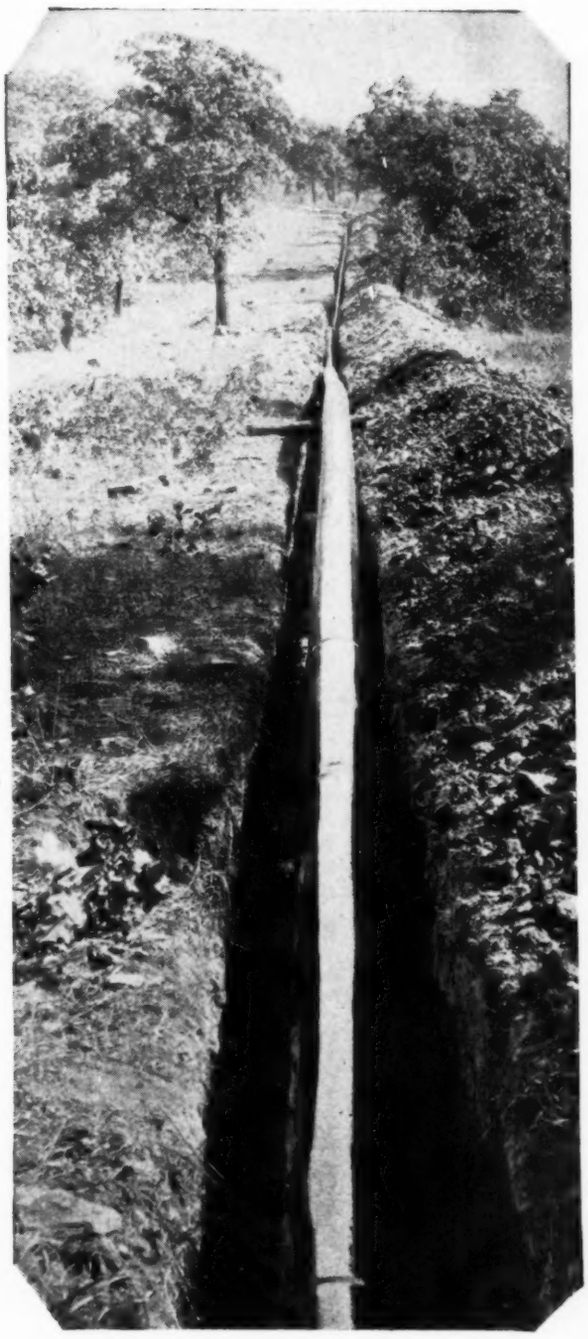
SHEEHAN

PIPE LINE



CONSTRUCTION CO.

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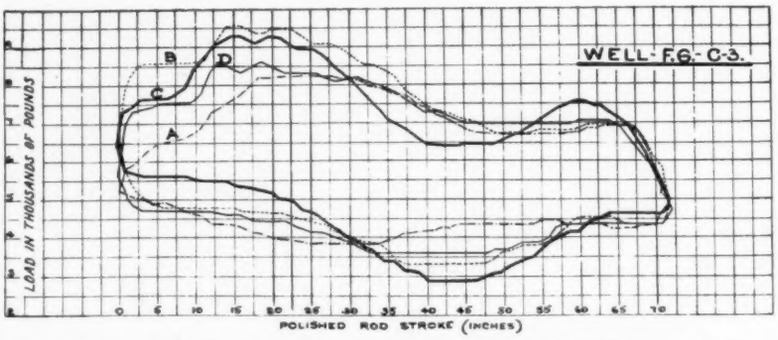
When writing SHEEHAN PIPE LINE CONSTRUCTION CO. *please mention The Petroleum Engineer*



EFFECT OF AMOUNT AND POSITION OF COUNTERBALANCE

CARD	LENGTH STROKE	STROKES PER MIN.	H.P. AT MOTOR	H.P. AT POL. ROD	REMARKS
A	72"	21"	16.67	10.65	4700 LBS COUNTERBALANCE WITH CRANK
B	72"	21"	19.43	13.93	4700 " " LEADING CRANK 15°
C	72"	21"	18.68	12.1	4700 " " LAGGING " 15°
D	72"	21"	17.46	12.1	4400 " COUNTERBALANCE WITH CRANK
					5700 " CALCULATED CORRECT C-B.

REDUCTION GEAR UNIT- ROTARY COUNTERBALANCE
PUMPING DEPTH 2675 FT - 2½ TUBING - ¾" RODS.

FIG. 6

Then the most efficient counterbalance for power consumption is equal to the weight of the rods plus one-half of the fluid load less one-half the weight of the fluid displaced by the rods. By weighing a well, the correct counterbalance can be accurately determined as all factors affecting the rod loading are taken into consideration. From an indicator card the theoretically correct counterbalance weight is equal to the load on the downstroke of the card plus one-half the difference between the load on the upstroke and downstroke, or, in other words, is equal to the load corresponding to the mean height of the card and conforms to the formula above, with all factors affecting the rod loading taken into consideration. For example, to stress the importance of counterbalancing, consider the stresses involved and the horsepower necessary to operate a balanced and an unbalanced machine. Assume a well with an average load of 7,000 pounds on the upstroke of the rods and an average load of 4,000 pounds on the downstroke. The theoretical correct counterbalance is then 5,500 pounds. From formula (2) Wp = 7,000 — 5,500 = 1,500 pounds on the upstroke.

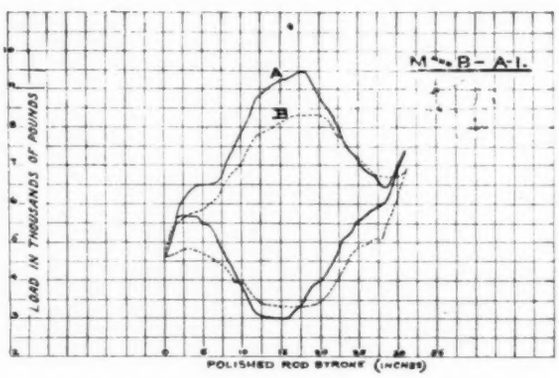
Wp = 5,500 — 4,000 = 1,500 pounds on the downstroke, and thus is obtained a constant belt or gear tension equivalent to 1,500 pounds force at the crank end of the beam on both the up and down strokes.

Let the well be underbalanced 1,000 pounds and on the upstroke and downstroke forces of 2,500 pounds and 500 pounds respectively are necessary. Remove the balance altogether and a force of 7,000 pounds on the upstroke is necessary and the rods are driving the crank with a force of 4,000 pounds on the downstroke. The stresses that would be put on the belt, engine and rig, are apparent. If no counterbalance is provided, the prime mover must be adequate to provide the maximum lift of 7,000 pounds but when correctly balanced with 5,500 pounds, a prime mover need only supply 1,500 pounds net force.

The polished rod load will not be affected as readily as the power end by changes in counterbalance. Changes of less than 400 pounds effective counterbalance weight usually produce little change in an indicator card, but changes over 400 pounds may affect the rod load considerably. With electric power, the effects of counterbalancing at the power end can be determined by the use of electric recording instruments. With other types of prime movers the dynamometer is the only practical method available. The most efficient counterbalancing, as determined at the power end, does not always produce the best pumping motion and a medium derived from studies at both ends will produce the best results.

Figure 6 shows cards taken on a well with a reduction gear unit and rotary counterbalance. The theoretical correct counterbalance, as determined by the dynamometer, is 5,700 pounds. Card A, taken with the amount of balance closest to the correct amount and directly with the crank, produces a lower power consumption and a smoother pump motion. Card D, taken with 300 pounds less weight but in the same position, has a slightly higher power and polished rod load with the shape of the card about the same. Card B and Card C were taken with the same amount of balance as Card A, but leading and lagging the crank by 15 degrees respectively. By leading the crank an impact load occurs at beginning of the upstroke, when by lagging the crank a slight impact load occurs early in the upstroke and again late in the stroke. Both positions of the counterbalance when set off center resulted in a very uneven power load at the motor.

Figure 7 shows two cards, one taken on a well that was overbalanced and the second taken when the counterbalance weight was reduced to the correct amount. Very little change was made in the horsepower load at the motor or the polished rod, but a much smoother rod motion is obtained when the counterbalance weight approaches the correct amount.



EFFECTS OF COUNTERBALANCING.

CARD	LENGTH STROKE	STROKES PER. MIN.	H-P-AT MOTOR	H-P-AT POL. ROD	REMARKS
A	31"	21"	7.98	4.49	6400 LBS. COUNTERBALANCE
B	31"	21"	7.92	4.36	5600 " "
					5700 " CALCULATED CORRECT W.T.

REDUCTION GEAR UNIT- ROTARY COUNTERBALANCE
PUMPING DEPTH 2650 FT.- 2½ TUBING - ¾" RODS.

FIG. 7

First Again!

We now announce the First Fully Heat Normalized from End to End Sucker Rods

No catch phrases — No trick words

Jones High Manganese Fully Normalized Steel Sucker Rods represent the greatest step in advance in sucker rod manufacture since we introduced our now well known High Manganese Steel Sucker Rods. These new rods, fully heat normalized in the world's largest slot type sucker rod furnace, insure

Uniform Texture from End to End
Greater Fatigue Resistance

Producers, engineers and production superintendents are cordially invited to visit our plant and inspect our modern equipment.

Equip your next deep well with these new and better sucker rods. Write for our new booklet just off the press.

THE S. M. JONES COMPANY

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Metallurgy *of* Hard-faced Rotary Drill Bits*

By W. A. WISSLER,
Research Engineer, Union Carbide & Carbon Research Laboratory, Long Island City, N. Y., and C. W. Metzger, Sales Engineer, Haynes Stellite Co., Houston, Texas

THE metal or metals in an oil well bit must perform two functions. One of these is to cut or crush the rock or other formation encountered in the hole, and requires a cutting edge that is hard when in use and highly resistant to abrasive wear. The other is to back up the cutting edge and transmit to it the energy delivered by the source of power; this requires a metal having considerable toughness, strength, and resistance to shock. These uses are so different in character that no one metal or alloy could be expected to be the most suitable for both.

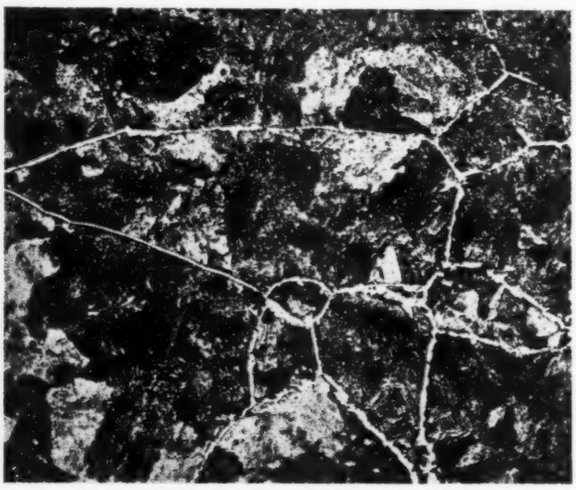

Fig. 1. Overheated bit.

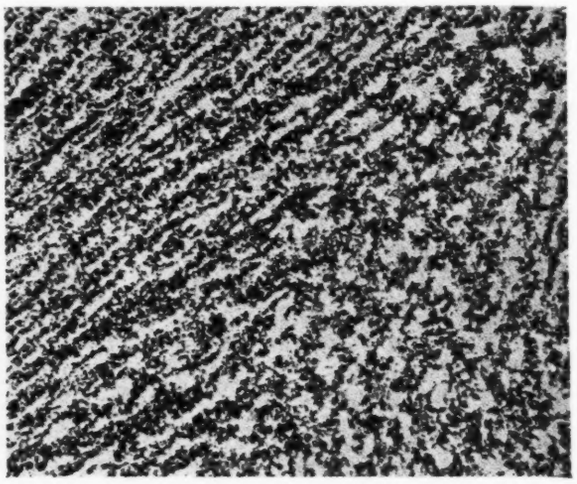

Fig. 2. The steel bit before welding.

For many years both cutting edge and body were made of one piece of metal, and it was necessary to select a steel that combined both of these requirements to the highest possible degree. More recently the development of the hard-facing process has enabled the driller to combine two or more different metals, using a strong, tough steel for the body of the bit, and a wear-resisting, although somewhat brittle, metal for the cutting edge. The use of two metals, each having been selected as being the best for its particular purpose, has increased the efficiency of the bit and has resulted in great drilling economics that need not be discussed here. The advantage of using hard-faced bits is now admitted almost universally.

A discussion of the metallurgy of hard-faced bits must therefore be divided into three sections. The first of these deals with the steel used for the body of the bit; the second concerns itself with the character of the welded junction between the steel and the hard facing alloy; and the third discusses the alloys used for the cutting edge. Each subject will be taken up in the order given.

*Presented before the Fall meeting of the Texas-Louisiana-Arkansas district of the A. P. I. division of development and production engineering at Galveston, Texas, Sept. 5 and 6.

The Steel in the Bit

The main duty of the steel in the body of the bit is to deliver the power for drilling to the cutting edge. To do this it must be tough enough to resist drilling stresses without breaking, stiff and hard enough to properly support the hard facing metal, and in addition, of such a nature that it may be repeatedly redressed and hard faced with a minimum of deterioration in quality.

Many brands and compositions of steel are used for fish-tail bits. Some of them are plain carbon steels—others are alloy steels containing manganese, chromium, nickel, vanadium, etc. Each driller has selected one or more steels that he thinks are the best for his particular conditions. Most of them, perhaps all of them, are good steels for the job. Some of them will obviously stand more difficult and severe operating conditions than others, but each of them is preferred by someone in the drilling game.

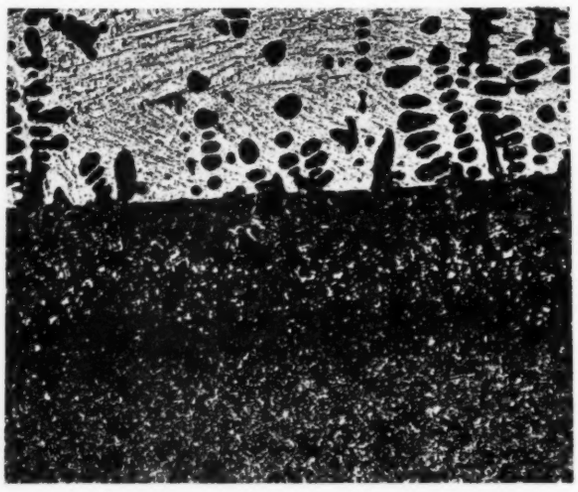

Fig. 3. Carburized surface produced by the reducing flame.

Fortunately, it is easy to buy good steel. Steel mills and laboratories have spent, and are spending, large amounts of money and time in making steel of high quality by controlling carefully every step in its manufacture. It is, however, unfortunately true that a good steel may be partly or wholly ruined between the time that it leaves the maker's hand and the time that it is put to use. It is easily possible to handle the best steel in such a way that the final results obtained from its use are much less satisfactory than

(Turn to page 178, please)

An Invitation from the Oil Industry's Big Bank... to the Oil Industry's Representatives

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could be obtained from a cheaper steel properly used.

Whenever steel is heated or worked it is essential that the proper temperature and conditions be used. Owing to the great variety of steel used for bits, it is impossible to lay down definite temperatures or conditions. General Rules may be discussed, and detailed information may be secured from the manufacturer of the particular steel in use. The properties of a steel are largely dependent on the manner in which its constituent elements are combined, and also on the size of the grains into which they are crystallized. Other things being equal, the most desirable structure is one consisting of small grains, such as is found in a steel that gives a fine structure when broken. This condition is necessary if the steel is to have high strength and impact value. Anything that tends to leave the steel with an excessively large grain should therefore be avoided.

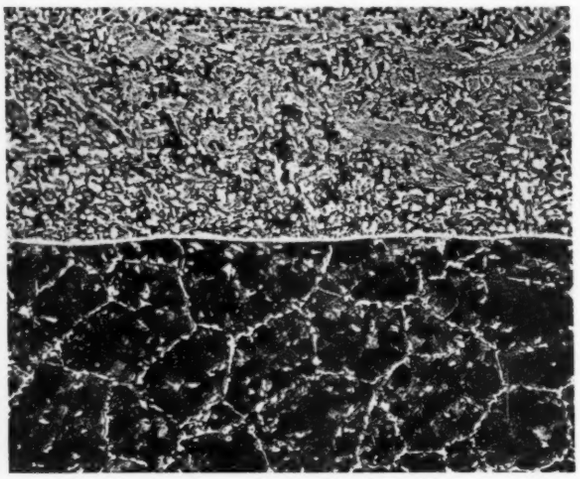


Fig. 4. Finished weld.

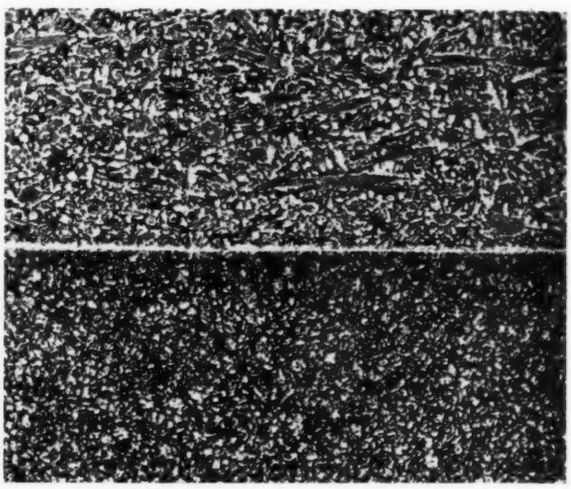


Fig. 5. Stellited bit quenched in oil.

One of the surest ways to produce a steel having exceptionally large grains is to overheat or burn it. Burning a steel consists in heating it to such a temperature that the grains become large and the grains boundaries are greatly weakened. Such steel is very weak and it is impossible to restore its proper properties by any method short of remelting and working. Rather high temperatures, in the neighborhood of 2,400 degrees Fahrenheit or higher, are needed to produce badly burned steel, but it is possible to burn the thin edges of a steel bit if heating for forging is done in too hot a furnace. If this should happen the only remedy would be to cut off enough of the bit to remove the burned portion. Badly burned steel will usually crack during forging, and a simple test consisting of attempting to forge or examining the strength of a piece of burned steel will show the great decrease in toughness resulting from such treatment.

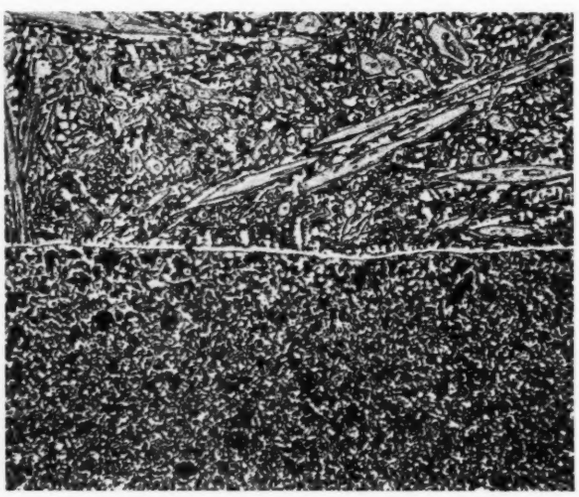


Fig. 6. Stellited bit air-cooled from 1600 degrees F.

A sample of a bit overheated to the burning point is shown in Fig. 1. It may be compared to the photograph Fig. 2 showing the same steel as received from the maker.

Forging should be carried out at a specific temperature range with the idea of starting at a certain temperature and finishing at a certain temperature, and the steel should be reheated rather than heated too high at the start to enable the forging to be completed with only one heating. Forging should not be done on a bit below this temperature range. Working the bit cold, particularly if the fishtail is stood on edge and the gauge is being forged, will likely start very small cracks inside the body of the metal. These cracks may perhaps be so small that they do not cause any immediate damage, but they have a tendency to spread under the stress that the bit encounters while in the hole. They will also tend to spread on further reheating or working. The importance of proper forging temperatures cannot be overestimated.

Hardening and drawing should be done according to the manufacturers' instructions. A hard faced bit can usually be quenched in oil without starting cracks. Often air cooling from the proper temperature will impart the necessary properties to be hard faced bit. Quenching in water should be generally avoided.

Careful inspection after forging or heat treating will usually reveal any cracks or other defects that might cause considerable trouble if undiscovered until the bit is in use.

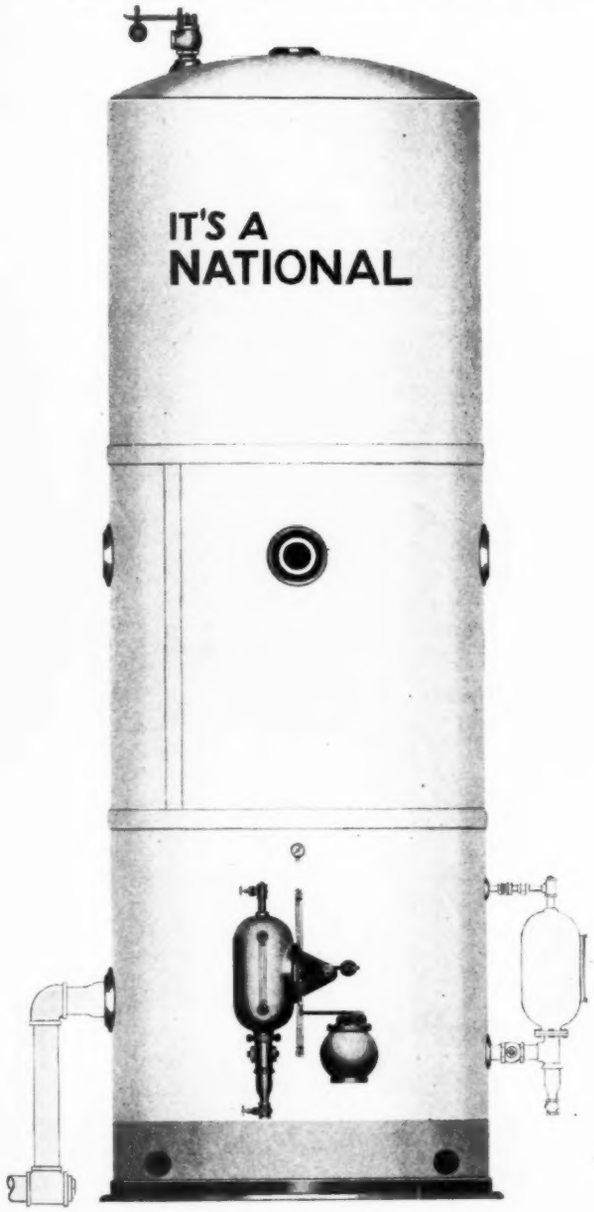
While the question of proper temperature is emphasized and is very important, it does not need to be held to such close limits that pyrometers are necessary. Variations of 50 degrees more or less are allowable, but the operator should be sure that he knows the proper temperatures and then he is able to judge them very closely. In case of doubt, the cost of a pyrometer would doubtless be repaid many times over.

It may be readily seen that considerable care is necessary if the steel is to be kept in its best possible condition. It is, however, fortunately true that steel will perform satisfactorily even though it is not in its best possible condition, and that therefore a certain amount of variation from the above recommended practices is possible. It is only when trouble of various kinds is encountered that it is necessary to examine the practice in use, and whenever this is necessary investigation should be conducted along the lines suggested by the above discussion.

Turn to Page 180, Please

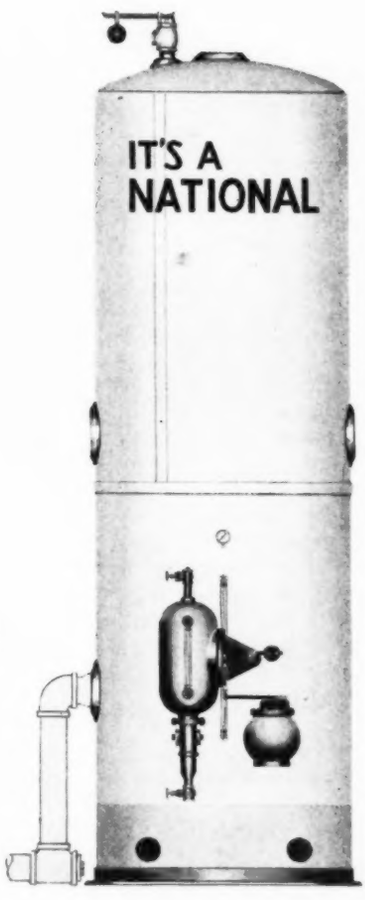
NATIONAL SEPARATORS

BULK SEPARATION AND MIST EXTRACTION

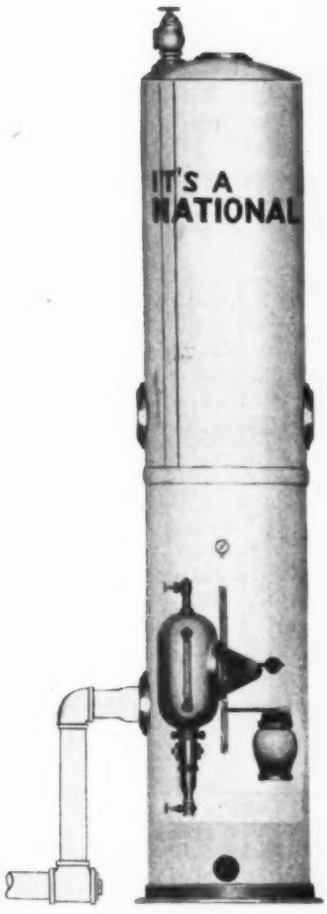


No. 1-A, 7'x22½', 125 lbs. Working Pressure. For use where unusual volumes of oil and gas are to be handled. Rated capacity, per 24 hours: 100,000,000 cu. ft. Gas; 30,000 barrels Oil.

Three Popular Sizes



No. 2-A, 5'x15', 125 lbs. Working Pressure. The ALL PURPOSE Separator. For unusually large wells, two of this type may be installed and when production decreases, one may be moved ahead. Rated capacity, per 24 hours: 30,000,000 cu. ft. Gas; 20,000 barrels Oil.



No. 4-A, 3'x15', 500 lbs. Working Pressure. The separator for extracting mist or gasoline from high pressure wells. Sufficient pressure may be carried to put the gas into industrial and high pressure lines. This separator releases gas scrubbed clean of light elements of oil or gasoline. Gas from this separator may be used for repressuring. Rated capacity, per 24 hours: 30,000,000 cu. ft. Gas; 3,000 barrels Oil.

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Junction of the Metals

The junction of the hard facing metal and the steel base must be at least as strong as the hard facing metal itself, as otherwise excessive breakage would occur at this point.

A strong joint may be made by either the oxy-acetylene or metallic arc welding process, but for the hard facing of bits the oxy-acetylene process has certain definite advantages. One of these lies in the fact that the arc welding process results in a loss of metal amounting to 8 or 10 per cent of the amount of rod used, which occurs by volatilization or by spattering and is independent of any metal lost by the failure to reclaim stub ends. When ordinary iron or steel welding rod is being used, the loss is of but little consequence. Hard facing metals, however, are high in price as compared to steel, and the loss of 10 per cent of the metal becomes quite an item. Any comparison of the costs of the two processes must take this point into consideration.

Another advantage of the oxy-acetylene process is that the metal built up on the cutting edge may be shaped much more accurately, with the result that less metal is required and very little grinding is needed to prepare the bit for use. This is quite an item whenever a large number of bits are to be hard-faced.

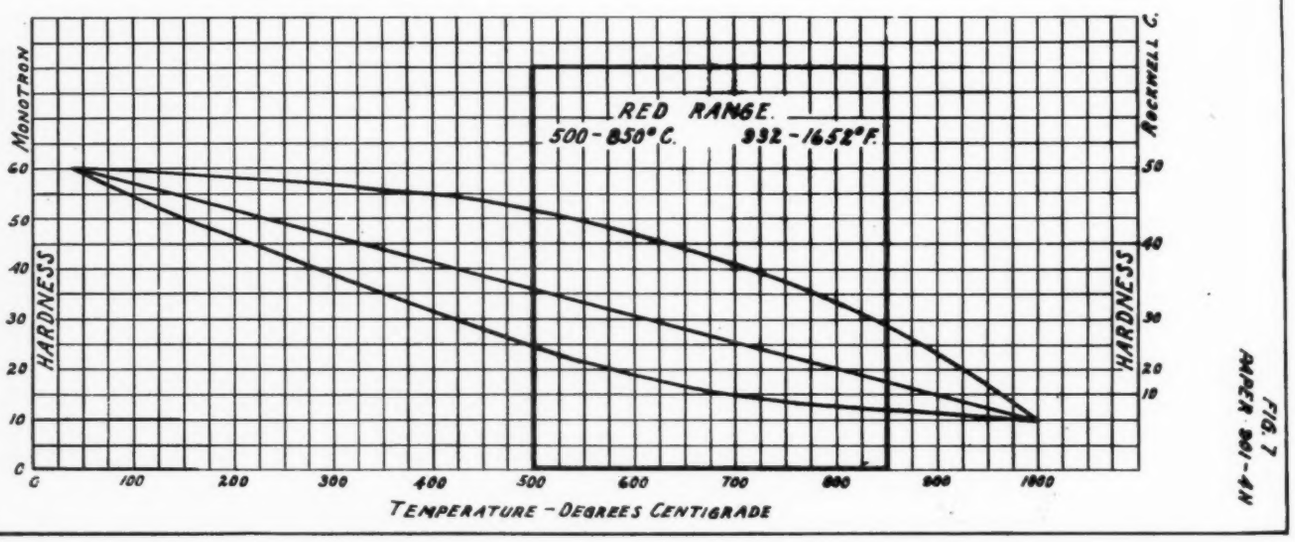
Still another advantage lies in the fact that a more uniform deposit may be obtained. In ordinary welding it is desirable to secure a certain amount of inter-alloying of the two metals, a result known to the trade as "penetration". When both metals are similar in composition, the result is beneficial and produces a strong weld. The hard facing process however uses two metals of different compositions, and hard-facing metals lose a considerable part of their wear resisting value if they are diluted with iron. The best process is therefore the one that keeps the inter-alloyed zone at a minimum thickness. The metallic arc process results in the production of an inter-alloyed zone from ⅛ to ¼-inch thick, while the oxy-acetylene process may be carried out so that practically no dilution takes place. The result in the one case is a deposit, the lower part of which is highly diluted with iron, and hence inferior in wear-resisting properties, while on the other hand the oxy-acetylene process produces a deposit having uniform properties throughout its entire depth. It is thus seen that the effective thickness of the deposit is greater if the oxy-acetylene process is used.

These advantages have resulted in the general use of the oxy-acetylene process for work of this type.

It is unnecessary to describe the process of hard facing in detail, as the manufacturers of the alloys used will furnish all necessary instructions to enable any competent welder to produce satisfactory hard-faced bits. As a general rule it may be said that three points should be particularly noted. One of these is to use a flame containing considerable excess acetylene; another is to avoid covering any particles of scale; the third is to allow the hard-facing metal to flow on the sweating surface of the steel. As a general rule the bit should be preheated before welding, unless it has been thoroughly annealed.

When the steel base is heated with a reducing flame part of the excess carbon in the flame is absorbed by the steel, the net result being the production of a thin surface of extremely high carbon steel. It is easily possible to carry this carburization to such a point that the steel will be covered with a surface of a carbide of iron containing almost 4 per cent carbon. Whether or not the carburization has proceeded to this degree, the result is the production of a thin surface layer of carburized steel, that, because of its high carbon content, has a melting point appreciably lower than that of the steel itself. Further heating by the welding torch brings this surface layer to the point of fusion, producing the phenomenon known as sweating. At the same time the reducing flame and the carbon content of the surface layer will thoroughly clean the surface by reducing any oxides that may be present. When the hard facing metal is melted and applied to the sweating surface, it presumably alloys with the thin molten surface and flows readily, wetting the surface thoroughly. The result is a junction that is uniform in strength, and at least as strong as the hard facing metal itself, having a very sharp dividing line, the inter-alloyed zone being less than 0.001 inch in thickness. This procedure is shown in Figs. 2, 3 and 4, which show the steel before being heated, the carburized surface produced by the reducing flame, and the finished weld. The photographs illustrated in Figs. 2, 3 and 4 were taken at a magnification of 100 diameters, and the thickness of the junction zone may be readily estimated. Experiments determining the hardness of the deposit have shown that its hardness is uniform down to within a few thousandths of an inch of the steel base, and analyses show that the metal

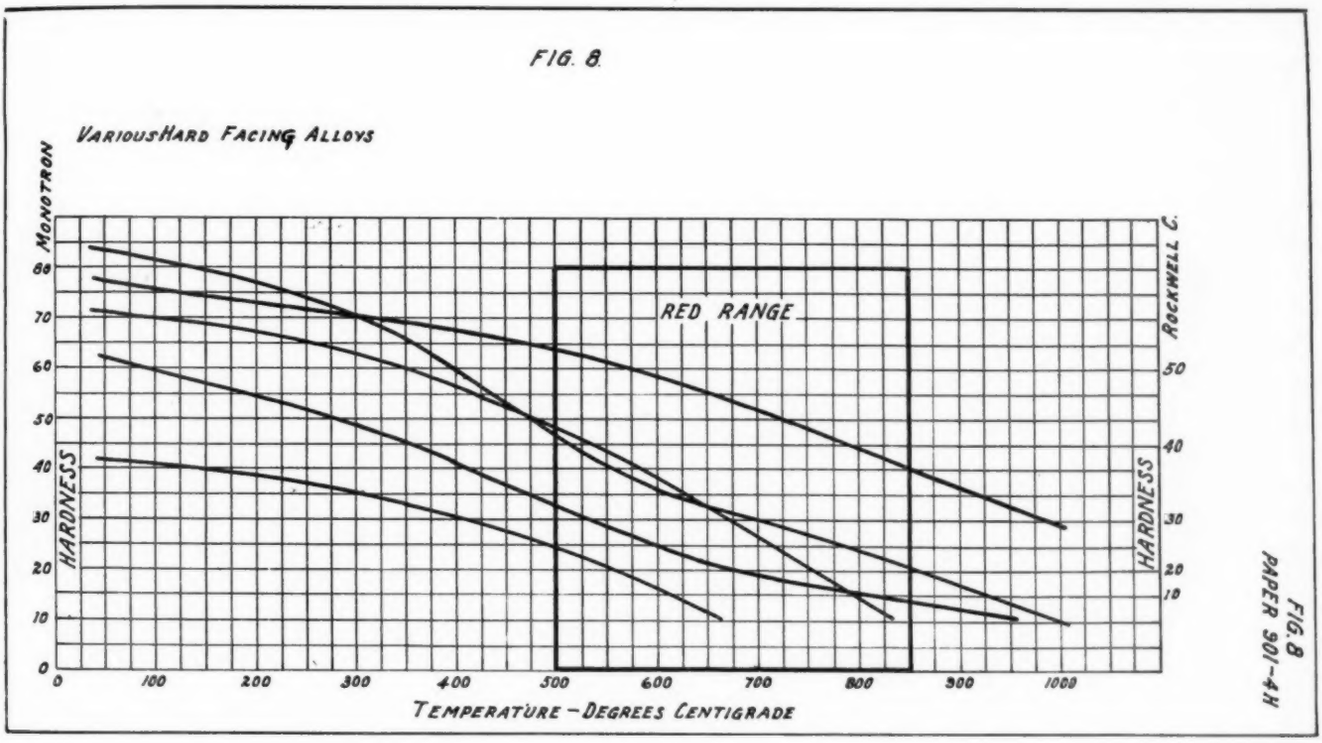
FIG. 7


MONOTRON HARDNESS
ROCKWELL C. HARDNESS
RED RANGE.
500-850° C. 932-1652° F.
0 100 200 300 400 500 600 700 800 900 1000
TEMPERATURE - DEGREES CENTIGRADE
FIG. 7

has been undiluted by iron. When the welding is properly done a junction of the two metals such as is shown in the photomicrographs will be fully as strong as the hard facing metal itself, and if samples are prepared in such a shape that they may be broken on a testing machine, the break will usually occur through the hard facing metal fairly close to the junction. In the case of one surfacing metal the breaking load will be about 40,000 pounds per square inch.

During the welding process the steel is of course heated more or less, and this heating will affect the grain size of the steel, as will be seen by comparing the steel in Figs. 2, 3 and 4. The steel in the finished weld is in fair condition, but obviously not in its best condition. The enlargement of the grains is of course most pronounced near the junction, where the highest temperatures were developed. Back of the zone the grain size decreases rapidly. Many users find that the bit as welded is satisfactory. If the best properties are necessary, the welded bit may be heat treated by being quenched in oil and drawn or normalized. Samples of the welded metal in Figs. 2, 3 and 4 were heated to 1,600 degrees Fahrenheit and quenched in oil, others were normalized by being heated to 1,600 degrees Fahrenheit and air cooled. Either of these treatments results in a great improvement in grain size, as is shown by Figs. 5 and 6. Quenching hard-faced bits in water is not recommended, as it may result in cracks.

FIG. 8



Cutting Edge Materials

The most desirable property of a hard facing metal is a high degree of ability to resist wear. This would, however, be of no value if the alloy were so weak and brittle that it would break or chip away in the hole, and therefore in addition to hardness the alloy should be strong and tough enough to resist the shocks and blows that it inevitably receives. Still another essential property is that the alloy must be of such a nature that it can be applied to the bit as a welded surface, uniform in quality and strength, and reasonably free from cracks and blowholes.

Hardness and resistance to wear are, to some extent, connected in the relation of cause and effect, and it is sometimes thought that a comparison of the hardness of two metals will predict their comparative value for hard facing. This is true, but only true if the hardness is measured when the alloy is in the same condition as when it does its work, which, as will be shown, means that its hardness must be measured at a red heat. Such measurements give a resulting figure that is called "Red Hardness".

Determination of the red hardness of different alloys will show their comparative value as wear-resisting materials, assuming that both are strong enough to stay in place on the bit. As far as is known it is the only test that will show comparative resistance to wear with the exception of an actual trial under operating conditions.

A large part of the energy used by cutting tools is converted into heat, which is liberated on the cutting edges or contact surfaces, and raises a very thin layer of metal to a surprisingly high temperature. These temperatures cannot be detected by ordinary means, but have been measured by laboratory experiments requiring extremely accurate and sensitive instruments. In many cases temperatures as high as 600 degrees Centigrade or higher have been measured on cutting and chipping operations, both when operating dry or "wet". The liberated heat is of course rapidly conducted away into the body of the bit, but as long as the bit is in operation its extreme cutting edge will be operating at temperatures that are well within the red range. This temperature exists only in a surface layer that is probably in the neighborhood of one ten-thousandth of an inch thick. Even the thin layer, however, contains an enormous number of layers of atoms, many of which will be worn away if the metal is softened by the developed temperature. This action is continuous while the bit is in operation, and the rate of wear will depend upon the hardness and to a lesser degree upon the toughness, of the metal when at these temperatures. This being the case, the most suitable alloy is the one that is the hardest while red hot, or in other words, the one that has the highest red hardness.

If all metals softened to the same degree when heated, a determination of hardness at ordinary temperatures would make it possible to predict red hardness, and thus foretell the ability of a metal to resist wear. This is, however, not

(Turn to Page 183, please)

THE ONLY BOMB BETTER THAN A ZERO HOUR BOMB IS TWO ZERO HOUR BOMBS - - - - - AND THAT'S THE ZERO HOUR DUPLEX

Super-

ECONOMICAL

...this new

DUPLEX Zero Hour Electric Bomb

Plug and Socket Connectors ... Improved Firing Pin

As a Kansas superintendent put it: "We can't afford to turn down the advantages of the new Duplex Bomb—for the few extra dollars it costs to buy one." Which illustrates the difference between *cheap* oil well detonators and *economical* oil well detonators. In buying detonators, as in buying machinery, transportation or other commodities, the thing that will do the work positively, accurately and safely is the most economical.

The new Zero Hour Duplex Electric Bomb is 99, 94/100% perfect. The chances of its failure to operate are too small to be computed in ordinary mathematics. These figures are what interest the operator who has a large investment and good opportunity for profit in an oil well that is completed and ready to shoot. He figures that the loss of time and production in cleaning out over a buried shot, let alone the danger, might cost him more than the price of any number of Zero Hour Duplex Bombs, one of which virtually eliminates that hazard. Hence the widespread conviction, among operators, that the new Zero Hour Duplex Electric Bomb, although it costs a few dollars extra, is something they "can't afford" to pass up.

Two Bombs in One

The Zero Hour Duplex Electric Bomb is, in effect, two bombs in one. The original Zero Hour Bomb, which contains one watch and one set of blasting caps, has been duplicated in the same size container, to the extent that it has two watches and two sets of blasting caps. In this way, two timing mechanisms, each independently powered by its own watch, are enclosed in the same metal, fluid-tight container which formerly held one only. Other new features include an improved firing pin, which can be moved backward and forward any number of times, in testing, without altering the firing point from "0," at which it is originally set. A new "plug and socket" method of connecting electric igniters and blasting caps materially simplifies loading operations and assures perfect electrical connections. Specify the Zero Hour Duplex Electric Bomb for all shooting.

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the case. Some metals soften in such a way that a curve showing the hardness at different temperatures would be almost a straight line. Other metals soften more rapidly when first heated and less rapidly at higher temperatures. Still other metals act in the reverse way to this.

Figure 7 shows curves of three theoretically possible alloys. All of these have the same hardness at ordinary temperatures and at 1,000 degrees Centigrade, but vary greatly in hardness over the effective range, which is enclosed by the rectangle. When in use, the active parts of bits faced with such alloys would show great differences in hardness and resistance to wear, and the metal possessing the greatest red hardness would be much superior in efficiency and life. Red hardness, which is the average hardness over the red heat range, gives a much better indication of wear resistance than any other laboratory test that can be made.

Red hardness is an attribute of the composition of the metal. The development of metals used for the cutting edges of oil well drills may be traced through plain carbon steel, allow steel, and ferrous hard facing metals, leading up to non-ferrous alloys consisting of cobalt, chromium and tungsten. Each of these types of alloys possesses greater red hardness than its predecessors, and each also contains less iron and a greater amount of non-ferrous elements. Non-ferrous alloys of the cobalt-chromium-tungsten type have greater red hardness than any other known hard facing metals, the use of cobalt instead of iron as a major constituent being apparently responsible for this superiority. Alloys containing iron may have a greater hardness when cold, but soften more or less rapidly when heated, and are much softer at red heats than the cobalt-chromium-tungsten alloys.

This greater degree of red hardness may be demonstrated by comparative drill tests in the field, or experimentally in the laboratory or shop. A simple test is to heat two or more alloys to the same high temperature, and test them with a file. A method giving fairly accurate quantitative results is to measure the hardness at the temperatures in question, which has been done in the laboratory by using a specially-equipped Monotron hardness machine. The curves shown in Figure 3 give the results obtained from these tests on a cobalt-chromium-tungsten alloy, and several hard facing metals that have an iron base. The results show that the welded cobalt-chromium-tungsten alloy has an average red hardness of 52 Monotron (C47 Rockwell) as compared to 30 Monotron (C23 Rockwell) for the ferrous alloys. This greater hardness under operating conditions accounts for its greater life as a hard facing metal.

Diamond Substitutes

After hard faced bits had demonstrated their value, hard set bits were developed. These bits have a cutting edge surfaced with a hard facing metal, but also containing inserts of so-called diamond substitutes that increase the rate of cutting and the life of the bit when used on certain formations. The hard inserts act somewhat like teeth, and cut grooves in the face of the rock, thus making it easier for the hard metal on the cutting edge to clean up the hole.

Diamond substitutes consist mainly of tungsten carbide and are all extremely hard. They have greater red hardness than hard facing alloys because they are considerably harder when cold and do not soften excessively when hot. Diamond substitutes of the extremely hard varieties are brittle and weak, and tend to crack when subjected to welding temperatures. To overcome this other elements are added with the object of increasing the strength and toughness, and decreasing the tendency of the diamond substitute to crack when it is subjected to the welding temperature. The final product is a compromise based on sacrificing some of the possible hardness to secure increased strength and toughness, and it is on the basis of these two properties that the value of the product must be estimated. It was formerly thought that hardness, as indicated by the difficulty encountered in grinding the material, and the melting point, were the two properties that should be investigated by the buyer. This is no longer believed, although both of these properties are obviously desirable. A good diamond substitute should be so tough that the inserts may be found extending like short fingers from the cutting edge after the hard facing material has worn away.

Diamond substitutes cannot be used as hard facing metals because of their extremely high melting point (4,200 degrees Fahrenheit or higher), and must be welded in place with more fusible metals. For this purpose they are supplied in the form of regular or irregular shaped pieces, or sometimes as powder. It is usually more economical to secure it in pieces fairly uniform in size and shape, as it is then easily possible to produce bits containing equal amounts. The use of a powder results in losses that often are as high as 30 per cent of weight of the powder used, whereas there is no loss when pieces of appreciable size are used.

Although the diamond substitute in a hard set bit does a large part of the drilling, the choice of the hard facing metal used to fill in between the inserts has a great effect upon the results obtained from the bit. The alloy selected must be capable of holding the inserts firmly, and must also have the highest possible resistance to wear. Diamond substitutes will cut only as long as they remain in position, and if the hard facing metal wears away between and around the inserts they may either become loosened and drop out or may have such excessive stresses placed on them that they will break away. For these reasons it is necessary to select the best possible diamond substitute and use it in combination with the best possible hard facing metal.

Discussion of Wissler-Metzger Paper

Mr. Ames stated that, according to Welton A. Crooks, noted metallurgist, microscopical examination of the steel structure of bits that had been in use in the field disclosed the fact that the working temperatures of bit steel in drilling operations run as high as 2,000° F.

For bettering bit service in the field it was suggested that the oil industry follow the example of automobile factories and appoint tool supervisors whose duty it is to see that tools are properly handled, especially as regards to bit pressures, bit speeds, dressing and type of bit to use under different conditions.

Regarding diamond substitutes, the German tungsten-carbide alloys are cast in blocks while these manufactured in America are cast by the centrifugal process.

According to Mr. Fletcher of the Hughes Tool Company, tungsten carbide alloy has been applied as a hard facing metal and the temperature required was about 6,500° F. As a hard facing material it was not successful. When applied it forms a thin sheath on the cutting edge. In this form it has no strength and scales off under service.

It was stated that some firms are now experimenting with Tungsten-Carbide-Cobalt alloys in an effort to do away with brittleness, so objectionable when tungsten carbide is used as a facing metal.

One member stated that steels, like foods, must be treated according to type and composition. Information, based on the type and composition of the metal, on the proper handling in the field, is available from the manufacturer.

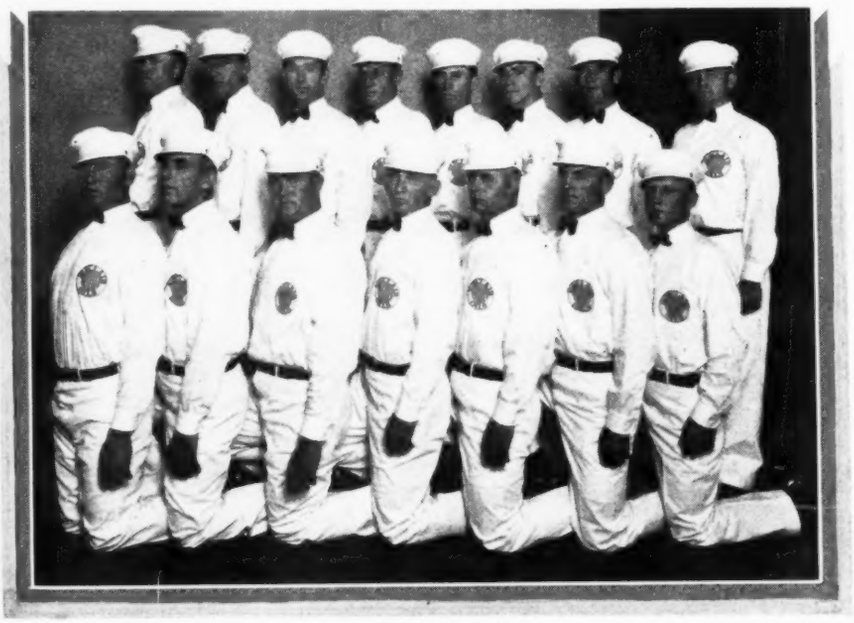
With the introduction of hard facing metals, the body of the fishtail bit has now come to be regarded as a structural member rather than a cutting tool, hence when fishtail bits are discussed, two phases of its usefulness must be considered, as a structural member and as a cutting tool.

Safety *in* Gasoline *and* Air-Gas Lift Plants

By H. B. BERNARD,
Vice-President Sinclair Oil & Gas Co.

ALTHOUGH the beginning of the Industrial era can properly be placed as contemporary to the steam engines of Newcomen, Smeaton and Watt, it is only within the past decade that the cumulative effect of the introduction of mechanical equipment has been climaxed in the new relationships that have grown up between employer and employee. The wide distribution of industrial securities has both brought employer and employee closer together and paradoxically has placed them further apart. Under present economic conditions the employee is also the employer insofar as he owns securities in the company for which he works. On the other hand there has been introduced between employer and employee, the management class and it is largely through this intervention that the new relationship in industry has come about.

The machine age has enhanced the importance of manpower, rather than to the contrary, due to both the greater productive capacity and the greater consuming power of the individual. During the past decade as never before there has been brought about a greater appreciation of the value of human life and it has become one of the dominant aims of industry to protect it and conserve it. This protection to mankind has been furnished through a campaign of safety, and on the effectiveness of this work the failure or success of an enterprise may largely depend. One of the leaders in the industrial world in the drive for safety is the Petroleum Industry. Inherently hazardous, it demands close and specific attention to detail of conditions under which work is carried on, in order that life and property may be safeguarded and preserved. Probably that branch of the industry which is engaged in the most consistently hazardous work is in connection with the construction and operation of gasoline and air-gas lift plants. To a great extent the labor employed has been intensively trained and is highly skilled. In order that operations may be conducted economically and efficiently it is incumbent upon the management that every possible measure be taken to properly maintain its staff at maximum effectiveness. The first step taken after conception of an installation of a plant is its location. The plant should preferably be located on high ground because gas pockets are apt to form in lower areas. Before construction starts the plant site should be adequately fenced to minimize exposure hazards and should have proper means of ingress and egress in order that only those concerned in the actual work be permitted the premises. All tools and equipment used in construction of the plant itself and of the pipe lines serving the plant should be of the best quality and be properly maintained. Proper sanitary facilities, including a supply of pure water, and adequate medical attention are necessities. Frequent inspection by those in authority is of prime importance. My organization goes to the extent not only of examining applicants for employment for physical defects and communicable disease, but insists that all employees take a bath and have their clothes fumigated to insure that they do not carry vermin.



Two safety teams of the Sinclair Oil & Gas Co.

In the general layout of the plant, facilities used for the storage of combustible liquids such as gasoline and oil, should be placed at lower elevations than that of the main plant buildings. In some cases storage tanks should be diked. Cooling towers should be so located that their danger as a hazard in the event of collapse due to toronado will be minimized; their placement should be such that water spray will not contact with electrical equipment which might cause short-circuiting. Boiler houses should be in such relation to other operating facilities that the normal tendency of escaping gas will not be in their direction. Needless to say in the location of any and all equipment, proper provisions should be made for accessibility in order that workers can handle it conveniently and expeditiously and not be subjected to unnecessary exposure to hazard. All buildings should be properly ventilated—this is of prime importance; gas is insidious and asphyxiation might occur without warning.

The choice of equipment and material to be used in gasoline and air-gas lift plants depends largely on the exercise of common sense. Taking two pieces of equipment of equal performance, of which one is obviously not as safe to operate as the other, permits easy arrival at a decision as to

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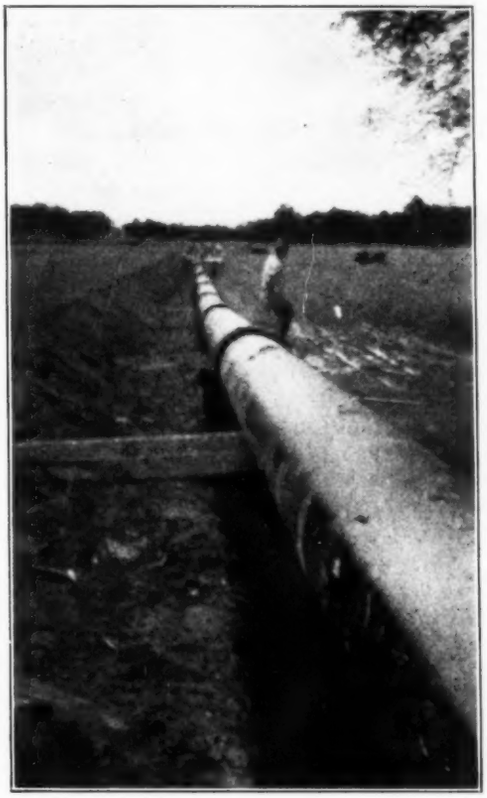
*Presented at the Annual Safety Congress, Chicago, Ill., October 3, 1929.



Scene on St. Louis Monroe 22' Line

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Sound engineering principles are necessary in the planning and construction of oil and gas pipe lines. When this knowledge is backed up by men of experience and a past record of high performance a good line within the specified time is assured.

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choice. All tankage must be designed with a liberal factor of safety. If the A. S. M. E. Code for Unfired Pressure Vessels is adhered to, no mistake will be made; similarly in the case of boilers. In the latter connection, the choice of water and water treating equipment is very important. A further safeguard lies in providing for boiler insurance in order to obtain inspection on an unbiased basis. In the design and installation of machinery, all moving parts must be adequately guarded and provisions for lubrication and maintenance should be made so as not to expose operators to hazards.

Electrical equipment should be of the most advanced safety type and preferably installed in places or buildings where the chances of having a gaseous atmosphere are slight. All electrical wiring and specialties should be installed under the National Fire Underwriters Code. Substantially designed buildings that will not vibrate are necessary, as vibration sets up stresses and strains in pipe lines carrying gas or gasoline that might result in rupture, and consequently invite accident. It is needless to say that special equipment such as heat exchangers, coolers, condensers, etc., and pipe, valves and fittings should be properly designed and installed with adequate factors of safety to withstand the maximum pressures and temperatures to be encountered. Too often are standard weight fittings installed where high pressure fittings are required, obviously resulting in unnecessary accidents; and, vice versa, frequently high pressure fittings are used where pressures will never exceed 50 pounds or 100 pounds, resulting in unnecessary waste.

The cost of carelessness.

Handling Heavy Machinery

As handling heavy machinery is a necessary part of plant operation and maintenance, the installation of a crane is preferable to the use of temporary equipment rigged up for a particular job, as the latter involves unknown factors with a consequent increase of exposure to accident. To meet the contingency of fire or explosion, properly placed fire fighting equipment should be an integral part of any plant, and all plant employees should be trained to be familiar with its use. In laying out piping, adequate and properly placed drips, check valves and safety valves should be installed. This is particularly true in the case of starting air compressors where air saturated with oil vapor forms an explosive mixture. Similarly, scrubber tanks, accumulator tanks and headers should be equipped to prevent carrying over of liquids into compressor cylinders.

Of prime importance, particularly in the operation of air-gas lift plants, is that the plant not be switched over from air to gas or vice versa under pressure, as a tremendous exposure to accident is involved. All plant and field lines should be thoroughly purged when such a switch-over is necessary. It should be an imperative duty to properly maintain all equipment irrespective of its nature, that is used in connection with plant and field operations. Unfortunately many accidents result from the attitude "We'll fix it tomorrow," or "It's working good enough to get by on."

A discipline comparable to that in army regulations is concomitant with the maintenance of a high morale and esprit de corps. Outstanding in the promotion of safety is proper educational work. Each accident should serve as the basis of a sermon for the prevention of similar accidents. Descriptive signs and bulletins should be located in and about all plants, and the bulletins should be changed at intervals to maintain employees' interest. Monthly meetings are highly desirable both for general instruction purposes and to have employees discuss among themselves the cause and prevention of accidents, specifically and in general.

Sinclair Company's Safety Rules

Nearly twelve years ago Sinclair Oil and Gas Company prepared its first "Safety Rules," which with modifications and revisions from time to time has admirably served the cause of safety. The present "Safety Rules" follow—

1. Plant operators will not leave the plant at any time during their tour. Employees will not wear coats with loose sleeves or skirts. Shirts and jumpers should be tucked into trousers. Company unionalls are available for regular employees.

2. Any defects in buildings, machinery, stairs, ladders, walk-ways, equipment, etc., must be immediately reported to the superintendent or chief engineer.

3. When serious or dangerous defects occur in a machine it must be shut down until repaired.

4. Never start an engine of over 35 HP by tramping the flywheels. Before turning an engine over render the ignition system inoperative. Toe boards, floor plates, guards and railings should be in place before starting any machine.

5. Never stop an engine by pulling off or disconnecting the ignition wires; shut off the gas.

6. If necessary to shut down the entire plant, in case of emergency, pull out levers of fuel pressure regulators on engine fuel gas line. All primary valves must be tagged and all employees must be familiar with their service and location so that in the event of fire the proper valves may be shut to keep the inflammable product from fire.

7. All employees must be familiar with the location of fire fighting equipment and the methods of using and charging same. There must be affixed to all extinguishers a tag showing by whom and when it was last charged. Fire plugs are painted yellow so as to be easily identified. The fire signal is repeated short blasts of the whistle.

8. Smoking or carrying "Strike anywhere" matches inside of the plant fence or buildings or around loading racks is prohibited.

9. Magnetos, spark plugs and other ignition devices must not be tested, repaired or assembled in any building or place where gas or gasoline vapors might be present.

10. All electric lights in any building or place where gas or gasoline vapor might be present must have vapor-proof globes and must not be lighted unless same are in place. Extension lamps are to be kept in order at all times and should not be used unless they have approved cords and vapor-proof globes protected by metal guards.

11. Electric light bulbs must not be removed from or placed in any circuit either inside or outside while the current is on. Electric flash lights must not be switched on or off where gas or gasoline vapor might be present.

12. Waste rags must be kept in cans provided for the purpose except when actually in use. Waste or rags must

(Turn to page 189, please)

not be placed around the machinery to catch drip oil. Rags must be hung up to dry only in the place provided.

13. Tools when not in use must be kept in the racks and cabinets provided. They should not be left on floors, machinery or walk-ways.

14. The use of iron hammers in any building or place where gas or gasoline vapors might be present is prohibited. Copper hammers are provided.

15. When work is being done in boilers, the "Man in Boiler" sign must be in place. When work is being done in a tank or tank car the "Man in Tank" sign must be in place.

16. The mesh wire guards on gauge glasses must be securely placed at all times.

17. Tanks and tank cars must be free from gas and gasoline vapor before any one enters them. If possible steam them out. Men must not enter tanks or tank cars without gas mask in place and without having rope attached to their bodies and someone stationed on the outside to operate the mask blower and pull them out in case they should be overcome by gas.

18. None but company automobiles are permitted inside the plant fence or buildings.

Community house of Sinclair Oil & Gas Co.'s safety chapter No. 4 in the Garber, Okla., field.

19. No persons except officers and employees of this company and Federal and State officials or inspectors provided with properly signed and sealed identification cards are permitted inside the plant without a permit from the Tulsa office. All persons not employees of the Gasoline Department must fill out and sign the "Visitor's Application and Agreement."

In summary, the major problem of safety may be unequivocally stated to be the question of plant personnel. Common sense prevents accidents and makes for a harmonious organization.

The story of safety can be told neither in a few words nor in a few days. It must be constantly repeated and reechoed, and revised to meet changing conditions. The biggest thing in life is human relationship. Through the mutual interest in safety work there has grown up between employer, manager and employee a more sympathetic understanding of the reciprocal problems involved in industry, and a greater willingness to co-operate in a common cause, working to a common end.

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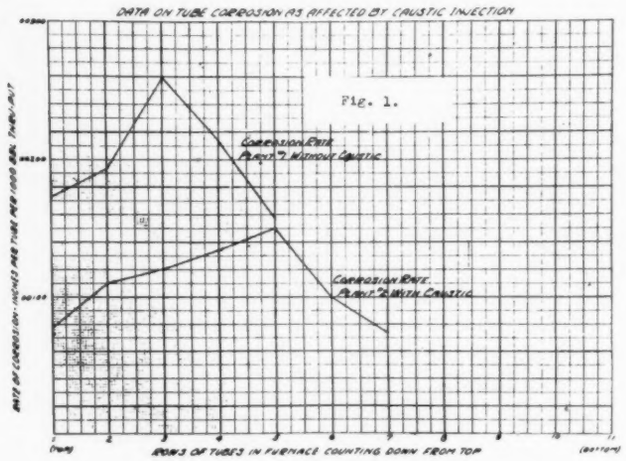
Combating Corrosion *in* Pipe Stills *with* Chemicals

By GUSTAV EGLOFF,
Universal Oil Products Company

CORROSION in distillation equipment of refineries is primarily caused by the action of hydrochloric acid and hydrogen sulfide. These two substances react vigorously with steel and the speed of corrosion is a function of the temperature conditions prevailing in the apparatus. Hydrochloric acid is generated by the hydrolysis of magnesium chloride in the brine water which is present in


DATA ON TUBE CORROSION AS AFFECTED BY CAUSTIC INJECTION
Fig. 1.
CORROSION RATE PLANT 2 WITHOUT CAUSTIC
CORROSION RATE PLANT 2 WITH CAUSTIC
ROWS OF TUBES IN FURNACE COUNTING DOWN FROM TOP

many crude oils. Hydrogen sulfide is dissolved in many sulfur crude oils as such, or will be produced by the breakdown of the sulfur compounds present in charging stocks. Of the two corroding agents which are primarily responsible for corrosion of distillation plants hydrogen sulfide is the most important, as it not alone reacts with steel but also deposits a scale on the distilling apparatus. This scale in contact with oil can burst into flame, and with hydrocarbon vapor present and a proper concentration of air, an explosion will occur.

Hydrogen chloride is more destructive in the cooler portions of the distillation apparatus particularly where water condenses whereas hydrogen sulfide is most reactive in the high temperature zone of the distillation apparatus such as the heating tubes, vaporizing of reaction chamber, vapor lines and dephlegmator.

A number of remedies have been suggested to prevent deterioration of pipe stills such as filtering crude oils to remove the solids which hydrolyze into hydrochloric acid or evolve hydrogen sulfide. Some experiments have been conducted to desulfurize petroleum oils by chemical means before the distillation operation takes place. However, no method has been put into commercial use so far. Until relatively recently the method for checking corrosion of stills was to build them of wall thickness sufficient to operate for several years under corrosive conditions before reaching a danger point. However, during the last few years a tremendous amount of work has been carried on in combating the problem of refinery corrosion. These endeavors have been along the line of injecting chemicals to neutralize the corrosive substances; covering the equipment subjected to corrosion with resistant metals or building the parts with non-corroding metals or metallic and cementitious liners.

The present communication reports on the injection of chemicals into distillation equipment in order to combat corrosion. The use of chemicals in distillatory systems such as the normal fractionation of crude oil or oils undergoing cracking has found wide application in the oil industry. Many tests of a laboratory character have been conducted and also in industrial units.

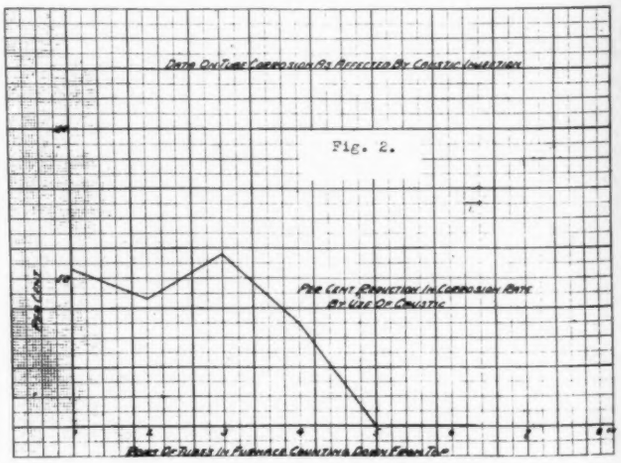
In commercial distillation apparatus instruments are used in order to measure the decrease of wall thickness of the various parts of the apparatus to determine the rate of corrosion. From these measurements the safety factor of the plant is estimated. From the wall thickness of the various parts of the distillation apparatus one can judge whether the chemical used is functioning as a corrosion corrective material. This yields a ready method of roughly following the corrosion rate in cracking equipment.

Mead[1] suggests that the product of cracking such as coke be analyzed for its iron content. He believes that it is possible to arrive at an estimate of the rapidity at which any given oil is corroding distillation apparatus. He also states that the results obtained by this method of estimating corrosion losses show surprising agreement with a system of periodic inspections. The agreement between the iron analysis of the coke and the inspection period showed an agreement of the order of ten per cent. He advises that the maximum amount of iron appears in the coke of the reaction chamber and tubes and very small quantities are present in the other products of cracking. He indicates the distribution of iron when treating gas oil in a cracking installation as follows:

	Per cent of Iron
Iron from the tubes	10.3
Iron in coke from soakers	85.5
Iron in coke from separators	3.3
Iron in water overhead	0.9
Total	100.0

The major criticism against this method of measuring corrosion rate for all commercial cracking installations lies

[1]American Petroleum Institute, 1927.


DATA ON TUBE CORROSION AS AFFECTED BY CAUSTIC INJECTION
Fig. 2.
PER CENT REDUCTION IN CORROSION RATE BY USE OF CAUSTIC
ROWS OF TUBES IN FURNACE COUNTING DOWN FROM TOP

Decrease in Corrosion of Cracking Unit Heating Tubes from Caustic Soda Injection.

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in the difficulty of obtaining representative coke samples. The writer has knowledge of one report made by an eminent European engineer who sampled coke from a reaction chamber and found an amount of iron present which calculated on the total amount in the reaction chamber, would have shown that it could not have lasted a month, however, the plant had been in operation at that time for a period of over two years.

The injection of chemicals for the protection of pipe stills from corrosion which have gone into general use are caustic soda, soda ash, ammonia and hydrated lime. Solutions of

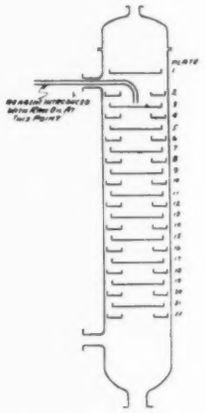


Fig. 3. Dephlegmator and Injection of Chemical Reagent

caustic soda are used both to check or neutralize the hydrolysis of salts and hydrogen sulfide. The alkali should be added to cold oil, because if the oil is hot, the water in the alkaline solution quickly is evaporated and the reagent does not thoroughly mix with the oil. As a result the caustic soda may be a corrosive agent itself in pumps and other equipment. The caustic soda solution is best added to the oil before it enters the dephlegmator. When thoroughly mixed with the oil and added at this point, the water will be flashed off in the tower, leaving the reagent suspended in the oil. At times the larger part of the caustic is pumped to the dephlegmator and a small amount passed into the discharge line of the hot oil pump. The amount of caustic added will necessarily vary, depending on the degree of corrosiveness of the oil. Typical is the addition of a 15° Baume solution of caustic soda in the proportion of about 0.2 to 0.3 per cent of the raw oil by volume. The solution used is often spent caustic soda from treating plants.

In a study of the effectiveness of caustic injection, it was found that its use reduced corrosion of the furnace tubes in the first three rows about fifty per cent and in the fourth row about thirty-five per cent. These results are shown graphically in Fig. 1.

Several tests have been made with dephlegmators to measure the effectiveness of caustic alkali. Fig. 2 shows the degree to which in one refinery corrosion of pans was checked by caustic. A second test showed a reduction of dephlegmator corrosion of about fifty per cent. When steel plates were suspended in a reaction chamber during runs with and without caustic the chemical reduced corrosion from fifty-five to sixty-five per cent. The refinery in which this test was made reported that injection of caustic soda into their cracking units caused a reduction of eighty per cent in the corrosion of dephlegmator pans and apparently helped the tubes, return bends, and plugs.

Mead[1] states that the use of caustic soda in petroleum stills practically eliminates the production of hydrochloric acid, and stops corrosion as measured by the amount of iron coming over in the distillate, but does not reduce the evolution of hydrogen sulfide. He gives the following table showing the result of caustic injection:

Charging Stock—Crane-Upton Crude

lbs. Caustic per bbl. of charge	Total HCl Overhead lbs. per hour	Total lbs. per hour	Total H_2S in Distillate lbs./hour
0.0	13.1	11.2	90.7
0.025	0.9	0.3	101.

He explains the data as follows:

"In the absence of any other acid, hydrogen sulfide attacks the iron of which the equipment is largely composed, forming iron sulfide. This iron sulfide is dense and coherent, and indeed appears to form an actual protective coating on the surface of the iron. In the presence of hydrochloric acid, formed by the hydrolysis of the alkaline earth metal chlorides which were originally present in the crude, this iron sulfide is dissolved to form ferrous chloride and hydrogen sulfide, which latter is then free to attack more iron and the cycle is repeated. This ferrous chloride is actually found dissolved in the water which comes over with the stream as the result of using steam in the battery."

"The maximum amount of corrosion occurs in the last gasoline stills in the battery, corresponding to temperatures of 450° F. and above. Thereafter it drops again to a very low value in the water white and gas oil cuts. It seems from these and other similar data that once the effect of the hydrochloric acid is neutralized there is nothing to fear from the hydrogen sulfide as a corrosive agent under the conditions of operation of the stills."

Other authorities do not agree with this mechanism of the corrosive action of hydrogen sulfide, but consider the hydrogen sulfide gas corrosive to all parts of the equipment, and state that sufficient caustic soda will definitely check its evolution.

It has been suggested that there is danger of caustic embrittlement in the use of caustic alkali in oil stills, similar to that prevailing in steam boilers.

Soda ash is preferred by some to caustic soda on the ground that it has less tendency to settle out on the walls of the still or tubes. With slightly corrosive crude oils, corrosion has also been successfully prevented by use of a mixture of soap solution and soda ash.

Hydrated lime is another alkaline reagent often used to check corrosion of distillation equipment. Hydrated lime

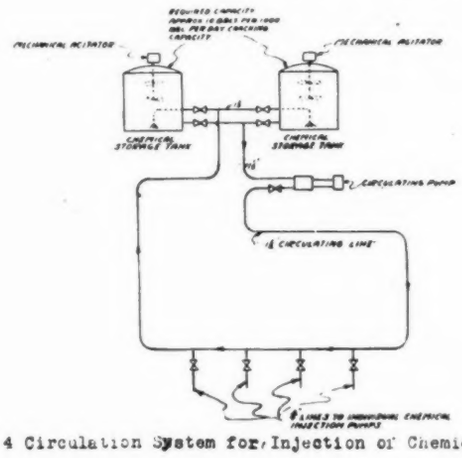


Fig. 4 Circulation System for Injection of Chemical Lime.

will react with hydrogen sulfide in the oil, it will also check hydrolysis of brine salts, and will make coke removal from a cracking still easier.

The most convenient way of adding this substance is to thoroughly mix finely divided slaked lime with a portion

(Turn to Page 195, please)

[1] Loc. cit., p. 237.

of the oil to be charged to the apparatus. The lime found most satisfactory is about two hundred mesh. The amount used ranges from three-tenths to one pound per barrel of oil treated. Hydrated lime is desirable in place of caustic soda due to its cheapness, and in part because the coke formed in non-residuum cracking operations, is more easily removed from the reaction chambers.

One commercial cracking operation in which no chemical was used, the coke in the reaction chamber was so dense—resembling concrete—that it took six days to clean out the chamber, men working with pick axes and the coke coming out a splint at a time. Then the use of lime was started, with the result that the reaction chamber containing the same amount of coke could be cleaned in from twelve to eighteen hours.

A typical analysis of cracking process coke with and without the use of lime, is given in the following[1] table:

Analysis of Cracking Still Coke

	Quantity of Lime Used	
	0.4 lb. per Bbl. of Oil Charged	None
Moisture	2.73	3.23
Volatile Matter	11.85	13.28
Fixed Carbon	78.71	81.94
Ash (inclusive of lime)	6.71	1.55
Lime	3.97	None
Su'phur	1.23	0.77
B. T. U.	14,252	15,219

It is also claimed that lime collects in the heating coil to a smaller extent than does caustic soda and that it produces distillate oil which is easier to refine.

In one refinery suffering severe cracking tube corrosion from a charging stock containing 2.1% sulfur, lime injections at the rate of 0.6 pound per barrel of raw oil reduced tube corrosion seventy-five per cent. Before this injection, tubes were at times lasting only nine to fifteen days. In one case a tube ruptured from corrosion sixty-four hours after an inspection had been made. Also, after one hundred thirty hours, thirty-one tubes were replaced in one furnace setting. When lime was used, the plant operated for months with no tube replacements.

Some difficulty was encountered in certain pipe stills with the use of lime because it formed a hard scale on the pistons and piston rings of the hot oil pumps. This was partially

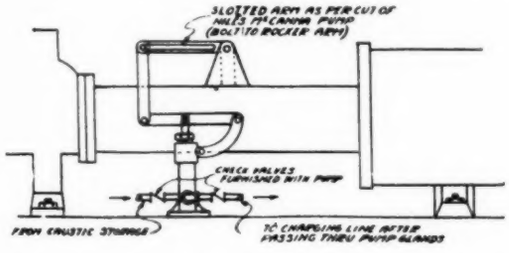
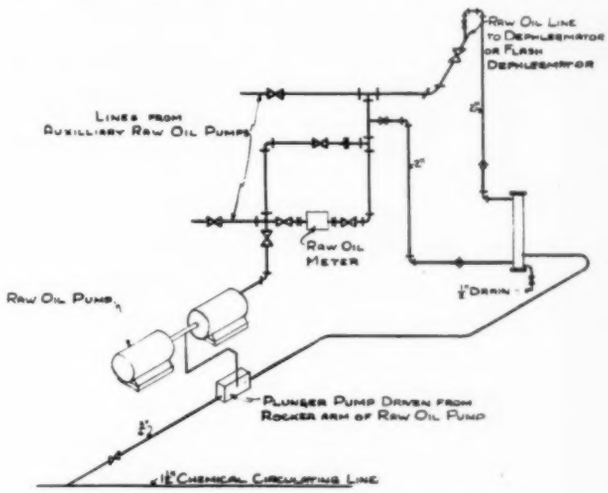


Fig. 5 Pump Mechanism to Control Injection Rate.

lime also formed a thin scale on the tubes, but not thick enough to cause the tubes to overheat.

Another company reported that it was found possible to cut corrosion to less than half by adding two or three equivalents of lime per equivalent of sulfur in the pressure still charging stock, but stated that this did not by any means stop corrosion, and thus the accumulation of solid matter and resultant danger from hot tubes or hot bottoms made the overcome by giving the piston rings greater clearance. The method of protection seem of little value. These results were obtained, however, in shell stills and water tube boiler type cracking installations. The velocity of oil movement is low in such systems and they are therefore not adapted to the use of solid chemical reagents to check corrosion.

In residuum operation of cracking stills, lime, or calcium



sulfide formed by the reaction of lime with hydrogen sulfide, remains in the residual fuel oil and may lower its commercial value. In spite of this one large company is continuing to use lime and has installed equipment to remove the lime residue from the fuel oil.

Hydrated lime is now in general use for checking corrosion in pressure distillation equipment. It has been found to be more effective generally than other reagents and is less expensive.

Ammonia has been used as an agent to combat corrosion. It will react with hydrogen sulfide and it can pass over with the vapors from a still and neutralize hydrochloric acid in the condensers. Both water solutions of ammonia, and the anhydrous substance have been employed. Ammonia is sometimes added along with lime or caustic soda. Its use is limited by its high cost as compared with other alkaline reagents.

It is claimed that acid corrosion may be checked by using an ammonia solution less in amount than the equivalent of the hydrochloric acid produced, as the water accompanying the ammonia dilutes the acid and also washes out ammonium chloride. Reduction of corrosion by fifty per cent following the injection of less than ten per cent ammonia of the equivalent of the hydrogen chloride in the system has been reported. In other cases an excess of ammonia over the hydrochloric acid formed in the system has been used. When anhydrous ammonia is used, it is necessary to flush out the condensers with water at intervals to dissolve the ammonium chloride formed.

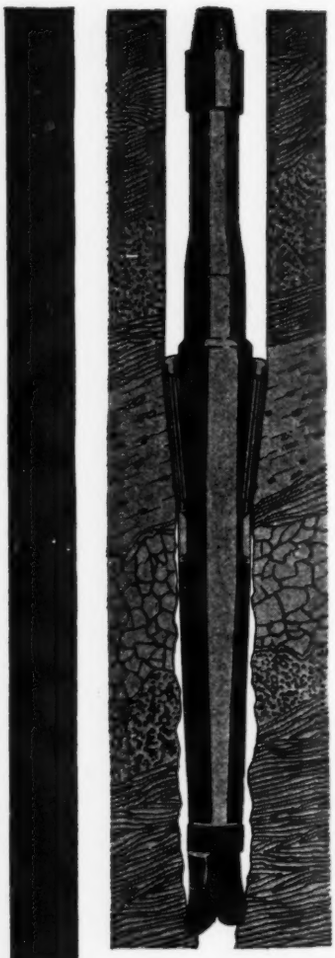
Ammonia may be added to the oil going into the stills, or injected into the vapor line of the system just before the vapors reach the condenser. If copper-containing metals are used in the condenser, excess ammonia must be avoided.

It has been claimed that ammonium sulfide and ammonium chloride, the products of reaction of ammonia with hydrogen sulfide and hydrochloric acid, are themselves corrosive agents, but this has not been definitely established.

Method of Injecting Chemicals Into Distillation Apparatus

Ammonia may be used in an anhydrous or aqueous condition and is primarily used for the purpose of neutralizing hydrochloric acid gas. It has been injected into the oil to be treated either in the suction side of the charging stock pump or into the pipe coil, reaction chamber, dephlegmator,

[1] Egloff and Morrell, Amer. Soc. Chem. Engrs., Dec. 5, 1927; *Oil Age* 24, No. 12, p. 42-4 (1927).



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or into the condenser coil, the point of injection being determined by experiment for each oil. It has not alone been used during the topping of crude oil and the cracking of heavy hydrocarbon oils, but also in the redistillation of cracked distillates in order to neutralize the acidic compounds produced during the sulfuric acid treatment of pressure distillate oils.

When caustic soda solution is used it may be varied in concentration, dependent upon the amount of corrosion which takes place in the distillatory process. The spent caustic soda solution from the treating process has utility and may be injected into the various parts of the system, dependent upon where the maximum corrosion takes place. This is a matter of experiment and one cannot state just where it will be most effective. A solution of soda ash may also be utilized for resisting corrosion in pipe still equipment. The concentration and amount fed into the apparatus is a function of the corrosive properties of the oil undergoing treatment.

Hydrated lime is suspended in a portion of the charging stock and is pumped into various parts of the system. In cracking equipment it may be injected into the dephlegmator attached to the reaction chamber or into the flash residuum dephlegmator.

In the drawing represented by Figure 3, a dephlegmator is shown which may be connected to the reaction chamber or the flashed residuum chamber of cracking still equipment and indicates the point at which the chemical reagent may be injected for the purpose of checking corrosion.

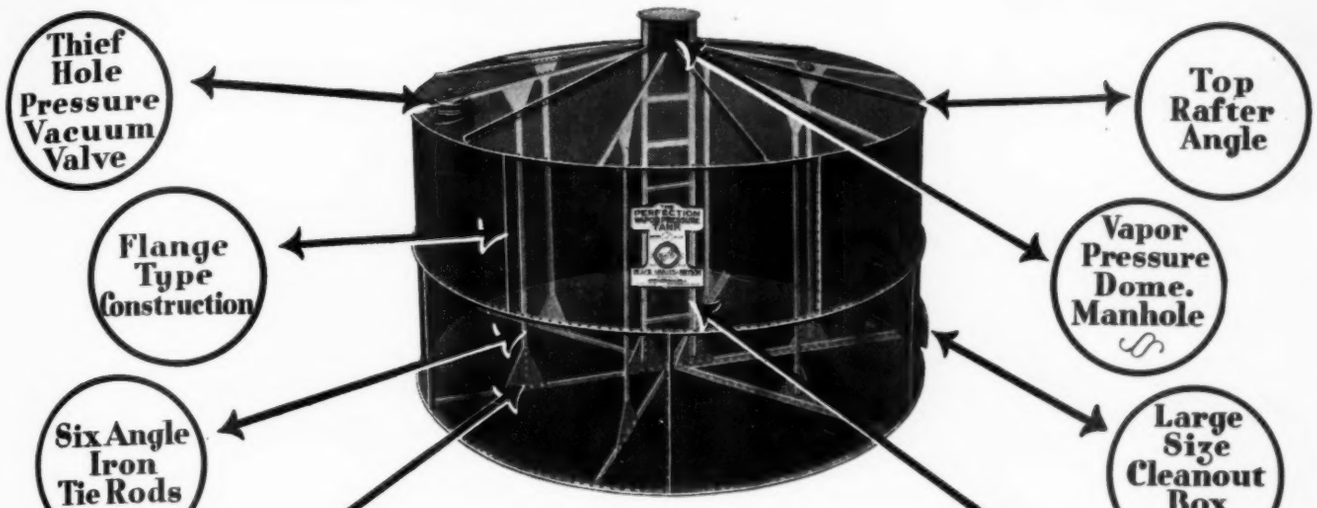
Figures 4, 5 and 6 show the mechanical mixing arrangement for the chemicals and pump mechanism for injecting the suspension or solution into the pipe still apparatus.

The study of the corrosion of distillation equipment has progressed to a stage where effective means are available for checking the corrosive influences encountered. But much remains to be done. Cheaper and stronger corrosion-resistant metals, more durable coatings, more accurate information of the extent to which chemicals can check the corrosion are present needs. Progress has been made, but much is yet to be accomplished before finis may be written on corrosion of distillation equipment, due to the wide variation of crude oils treated in the refining centers of the world.

AFTER you have read this issue of THE PETROLEUM ENGINEER, won't you please write us a frank letter, giving your impression of it? We shall appreciate knowing what you think of the articles and general appearance of the magazine. In your letter kindly mention any subjects in which you are especially interested.

By this assistance you will greatly facilitate our efforts to give you the most beneficial publication possible.

—THE EDITOR.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Here's a picture that tells a DOUBLE story! You can see both the outside and the inside of our tanks at a glance. Study the illustration, please. Note the flange type construction (there are four layers of metal plus our special packing to insure tanks being air, water, oil, and pressure tight). Note the slanting roof that allows the tanks to **"breathe"** and The B. S. & B. Thief Hole Pressure Vacuum Valve—**The Tank's Watchdog.** On the inside you may see the angle iron tie rods, plus the ladder, all of which add to the strength of the tank.

The B. S. & B. Safety Valve operates at 16-ounce pressure and 4-ounce vacuum. It thus prevents the light fractions of oil from evaporating, thereby saving all your oil and maintaining its original gravity; it protects the tank from bursting under pressure; it keeps it from caving in as the sun goes down, or as the oil is drawn out. **And it works automatically!**

—and Service that's on the Spot!

Oilmen believe in, expect, demand and need ACTION, and B. S. & B. are able to give it to them. We manufacture all our tanks and keep a supply ever on hand, not only at our factory, but at each branch, located THROUGHOUT the Mid-Continent and Rocky Mountain fields. There are 50 field stations at your beck and call! Tank crews are ever on the job and we do our own erection to insure accuracy, care and 100% efficiency. **From the factory to your lease in a few hours' time.**

May we give you some more INSIDE information about the B. S. & B. Perfection Tanks? We've a man near you now, and a catalog of the different sizes ready to mail. Address Dept. C-1.

X See Tanks on Display at Our Booth
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Black Sivalls & Bryson INC.
BARTLESVILLE - OKLAHOMA

Our Watchword QUICK SERVICE

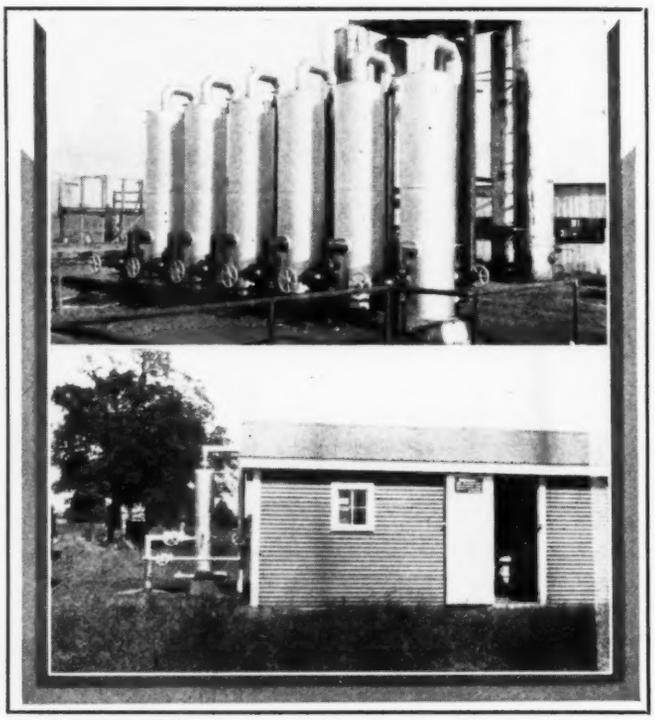
Solving Our Gas Line Dust Problem*

By E. F. SCHMIDT

Gen. Supt. and D. A. Sillers, Supt. Gas Meas., Lone Star Gas Company, Dallas, Texas

WHEN the Lone Star Gas Company first took up the problem of cleaning natural gas, it was suggested that in designing a separator, the case of a No. 4 Emco meter be used, as it was the best dust catcher we had experienced to date. In 1925 the company had a boom in the sale of drilling gas at a point located near the end of our long transmission lines. The resulting increase in velocity through this line picked up several years' accumulation of dust and dumped it into the meters through which most of this gas was being sold. We found meters with the diaphragms half full of dirt, and dirt piled up on the valve plate completely covering the valves and gears. A crew of men was kept busy repairing dead and slow meters due to this dirt trouble. As is usual in such cases, before a practical means of solving the problem was worked out the drilling boom was over. It took several thousand dollars' worth of new parts and labor to put these meters back into serviceable condition. Inasmuch as gas meters are designed to measure gas and not dirt, we could hardly blame the manufacturers for our trouble.

After our drilling boom was over we still had trouble with dirt cutting out positive meters measuring gas to towns along this same line. In changing an orifice at one city gate station along this line we found an accumulation of dirt on the upstream side of the plate that was over one-eighth of an inch thick at the pipe, tapering to nothing at the orifice. In checking this plate against the same plate cleaned off, we found the dirt resulted in measurement slightly over four per cent slow. We had been selling 40c gas through this plate, and decided that we were not through with the dirt problem.



Upper—Acme gas cleaners at Gordon gasoline plant in Texas. Lower —Gas cleaner, Emco regulator, and Emco large capacity meter on a Texas location.

We first purchased a type of separator using oiled hair or moss as a sort of strainer, and installed this device on a line to a small suburban district. Three days later this district was almost out of gas due to the separator clogging and almost shutting off the flow of gas entirely. From this we decided that any device using any sort of strainer that might clog up would not be practical, as continuity of service is the first law of the gas business.

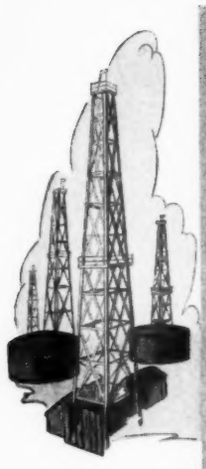
We next made up a separator using a tank two feet in diameter and four feet high. We used a tangential inlet located near the top and pointing slightly downward. The outlet was through a pipe extending down through the center of the top, and extending about eighteen inches below the level of the inlet. The theory was that the gas would swirl several times around the tank, the dirt and dust being heavier than the gas, would be thrown to the outside by centrifugal force, and would drop to the bottom, while the clean gas would be drawn off at the center. Later various baffles were used to protect the dust dropping to the bottom from the swirl of gas that we thought might again pick up this dirt. The separator did not separate. It seems that the dust particles are too fine for their weight to have any effect against the velocity of the gas carrying them. Incidentally, we noticed from indications inside the tank that gas does not swirl several times around a tank under these conditions. Momentum is proportional to weight, and the weight of the gas is comparatively small. The gas takes nearly the shortest path from the inlet to the outlet, and hardly makes a third of a revolution in the tank. This type of separator will remove large particles but not the very fine particles with which we were concerned.

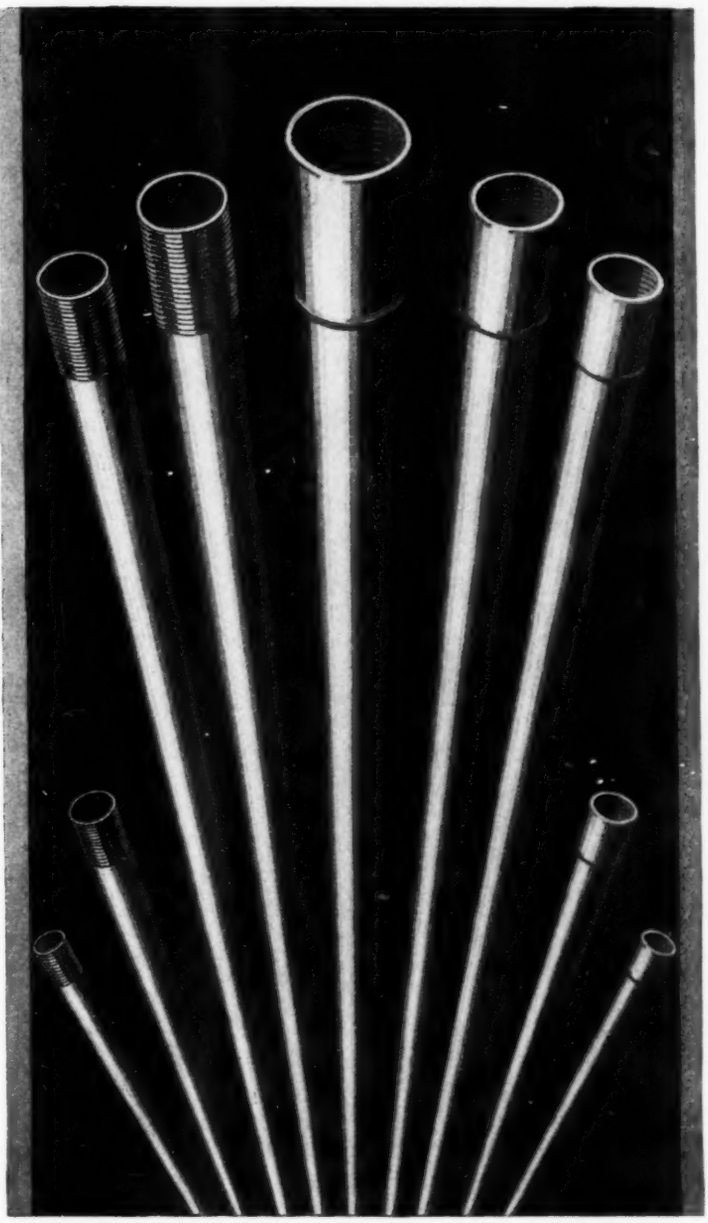
Examinations of the dust in the lines at different points showed some very fine particles of silica, evidently particles of fine well sand. However, this item has not given us as much trouble as it has some companies whose wells drill into a finer and looser sand than we have encountered. The most of the dust was composed of a magnetic oxide of iron, which was evidently pipe scale from the inside of new pipes; and a non-magnetic oxide of iron which is evidently corrosion of the inside of the pipe. This latter is much more abundant in pipe lines carrying residue gas from casing-head gasoline plants. This gas, of course, carries a small percentage of oxygen, which accelerates the internal corrosion of the pipe. The inside of one hundred miles of eighteen-inch pipe presents a surface of nearly two and one-half million square feet. A corrosion penetration of one one-hundredth of an inch thus results in the manufacture of about two thousand cubic feet of iron oxide. The fine character of this oxide is illustrated by the fact that we found that 90 per cent would pass through a 100-mesh screen. The high velocities resulting from fall and winter loads picks up the accumulation of this dust, and deposits it in compressor cylinders, gasoline plants, positive meters, and town distribution plants.

Traveling at high velocity the dust makes a perfect abrasive material for compressor valves, cylinder liners,

(Turn to page 200, please)

*Published through the courtesy of the Pittsburgh Equitable Meter Co.





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Another thing, you will like about Spang Pipe is the soft, easy working quality of the special steel—saves time and labor.

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When writing SPANG, CHALFANT & CO., INC., *please mention The Petroleum Engineer*

and rings, regulator valves, orifice plate edges, and valves and working parts of positive meters. It also clogs up gasoline plants, fills up diaphragms of large positive meters and domestic meters, puts automatic water valves out of service, clogs up industrial burners, and clogs up pipe fittings, and even main line pipe, decreasing the latter's efficiency very materially.

The fall and winter of 1926 this company suddenly experienced difficulty from all of the items mentioned in the preceding paragraph. The cutting out of low pressure regulators, and the putting out of service of automatic water heaters became a serious difficulty. We found that the Empire Gas Company had done a great deal of research and experimentation along this line, and had worked out an oil immersion type of cleaner that was giving excellent results. (See paper "The Cleaning of Natural Gas" by Mr. H. B. Milan, published in *Natural Gas* of June, 1927, and other publications of about this date.)

This device works on the principle of blowing the dirty gas into oil, which agitates the oil and brings it into contact with every particle of dust in the gas. The gas, carrying with it some oil is then passed through the upper chamber, where the oil is separated out by centrifugal force, and the clean dry gas passes out the outlet. The dust, no matter how fine, will cling to the oil. There is no restriction in the cleaner whose total area is less than the inlet pipe size, so that clogging is impossible. The dirt, settling to the bottom, is periodically drawn off with the oil.

Also the Acme Gas Cleaner Company, of Dallas, Texas, were putting on the market a cleaner using this design, with certain mechanical improvements resulting in increased capacity and lower construction costs.

Our first installation was on one of the main lines leading into Dallas. We had figured that it would take some time for the dust already in the town system to work out, but were surprised at finding that the complaints to the water heater companies practically ceased within two weeks. Within a few more weeks dust failed to show up in low pressure regulators, and we have had no trouble with it since. About this time we finished a thirty-mile line to a new town plant in Oklahoma. This line had been laid under very adverse conditions, and great quantities of dirt of all descriptions poured into the city gate measuring station and the town plant. We replaced the regulator valves and seats three times in ten days, finding them very badly cut out. We rushed a cleaner to this point and have had no trouble with these regulators since. Just as in the case of meters, it seems that a regulator correctly designed to regulate gas will not necessarily regulate sand and dust.

Gas cleaner and three Emco large capacity meters.

From the above experiences, we have made installations of Acme Gas cleaners protecting all of our large towns, and all of the small towns and industrial connections where dust has made its appearance. The results have been entirely satisfactory, and we believe that the cost of installations will be more than saved within two or three years in the saving in repairs, and the satisfactory and efficient operation of our meters and regulators. When the gas is made entirely clean we find the meters and regulators work more like the way the salesman said they would. We find our expense for parts has been almost eliminated. We have doubled the length of time between tests on our large positive meters, and find them so very nearly correct at each test that we are considering lengthening the period. This results in considerable saving, and we are getting much more accurate measurement.

The condition of the oil in the cleaners is determined by shutting off and draining the gauge glass, then refilling by opening the valves. This puts a representative sample of oil in the glass, and if it is too dirty it is changed. The 12-inch and 18-inch are serviced with a truck carrying a barrel of oil, an empty barrel, and a bucket, causing very little trouble. For the larger sizes we install settling tanks and filling tanks in connection. We use mineral seal oil or crank case drainings, whichever is most available, at city gate installations. We find that gas saturated with water at high pressure will evaporate all the water out of a cleaner at the lower pressures prevailing down the line where the cleaners are installed. However, water has been found to be the best cleaning medium in cleaners located at a compressor station where the gasoline content of the gas is relatively high.

A gasoline plant is generally a good trap for solid matter carried in natural gas. Some of this sediment remains in the absorbers, gradually filling them up, causing channeling and reduced efficiency.

We know of one case where the absorbers which were of the baffle type had almost completely filled with sediment. It had packed in the bottom of the absorbers so hard that it was a considerable task to remove it. Each absorber had to be shut down and steamed out to remove this material at a considerable expense. Acme gas cleaners were installed on the inlet of this plant and the trouble eliminated and the capacity of the absorbing towers restored to their original capacity.

With the advent of bubble cap absorption towers, clean gas is even more important because, due to the overflow arrangement necessary in the travel of the oil, a good opportunity is afforded for the heavier particles of foreign matter to drop out and gradually accumulate and cause serious trouble.

Some of these towers are provided with a series of valves, one in each tray which can be operated from a shaft permitting the trays to be flushed out periodically to remove the collected sediment. The best way to prevent this accumulation in any gasoline plant is by the installation of gas cleaners ahead of the plant.

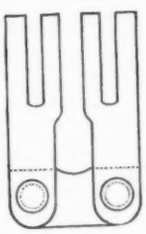
Mineral seal oil may be used and as it becomes saturated with dirt it may be drawn off and wasted. This does not

(Turn to page 202, please)

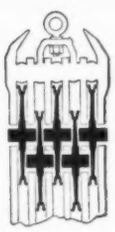
The Giant Regan

76"

Bigger Sheaves



Heavy Duty Roller Type Bale



Staggered Sheaves

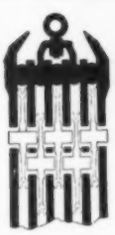
Famous Regan Dual Bearing

Improved Alemite Lubrication

More Weight

Streamlined Guards

Heavier Finger Guards



Extra Heavy Strap Construction

Heat Treated Pins and Clevis

See the Big Regan Exhibit at the Tulsa International Exposition Lot E

4 and 5 Sheaves

designed for Heavy Loads with High Speeds

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COPPER ALUMINUM ARMCO MONEL
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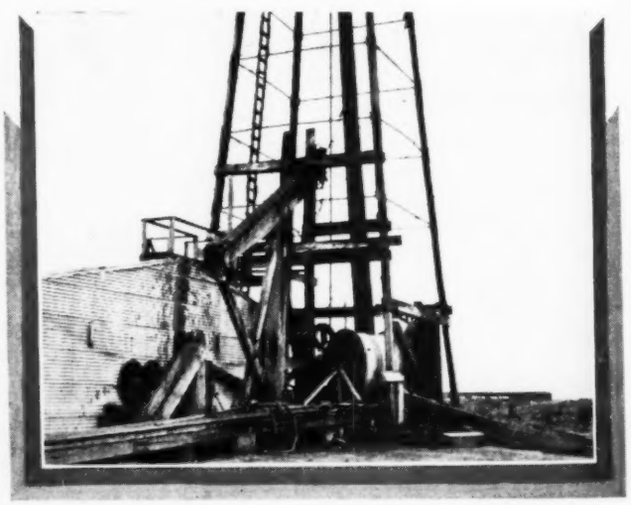
Standard Equipment With Leading Manufacturers
For GAS ENGINES COMPRESSORS CRACKING PROCESSES
PLAIN OR CORRUGATED
For Any Type Flange or Fitting
Built For Extreme Service
HIGH TEMPERATURES AND PRESSURES
MAKE TIGHT JOINTS
Reduce the Fire Hazard
McCORD RADIATOR & MFG. CO.
Detroit, Mich.

waste but a small amount of gasoline. Water may be used successfully, however, and can be drained off oftener and replaced under pressure with a connection to the boiler feed pumps providing the line pressure is not in excess of the boiler pressure. When oil is used the denuded oil pumps serve to refill. An accompanying picture shows an installation cleaning 60 to 80 million feet of gas daily at 300 to 350 pounds pressure. This gas is treated by modern bubble towers and no sediment has passed the cleaners since their installation.

In another modern absorption plant using bubble towers and gas cleaners, which were installed when the gasoline plant was built, the cleaners have removed all foreign matter, including small quantities of crude oil; and although the plant has been in operation for over a year the absorbing oil in the plant still retains its clear, clean color. This is good evidence of efficient cleaning of the gas and the cleaners by removing any crude oil and moisture help to prevent the possibility of the absorbing oil emulsifying.

In one of our compressor stations where the suction pressure gradually lowered and additional compressors were added to maintain the desired delivery, the increased velocity of the gas in the suction lines caused an accumulation of sediment to travel to the compressors. Compressor valves, rings, pistons and cylinders were soon worn and required replacing. It was found necessary to replace rings as often as each 24 hours. Cleaners were installed, using water as the cleaning medium. This completely removed the trouble from the compressors, reducing their maintenance cost to a minimum, and causing them to run much cooler due to the entire removal of the dirt.

We have concluded that we would not build a new gasoline plant or compessor station without cleaning the gas on the inlet. Even though the sediment may be slight at first it will increase as the lines get older and the velocity higher.



PICTURED above is the Continental Oil Co.'s well, Alberta Four Eyes No. 10 in the South Ponca field of Oklahoma. The spool on the derrick floor contains heavy electric cable preparatory to running in the well with the Arutunoff electric submersible pump.

This well was drilled with the Stone-Doheny drilling outfit, and was the first well in the Mid-Continent region to be drilled with this type equipment.

When writing McCord Radiator & Mfg. Co., *please mention The Petroleum Engineer*

A *New* Norvell-Wilder Supply House

..of the Oil Industry
..for the Oil Industry

This new Norvell-Wilder building at Houston is more than just a "perfect supply house for the oil industry," as so many who have inspected it have said. It is more than a beautiful and substantial brick building with every modern convenience for storing and shipping with the greatest speed,

Its bricks are the sturdy policies that for eighteen years have made the house of Norvell-Wilder a dependable one. Its steel girders and beams reflect the strength of character to adhere to methods that have built a supply house that has earned the abiding confidence of oil men who appreciate doing business with people whose word is as good as their bond. Its mortar and cement exemplify the ties of friendship with oil men whose deeds of action and genius have done more to create wealth in the Southwest than men in any other industry.

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Much Progress Made in

Long Distance Gas Transmission

AMONG the factors entering into gas utilities spreading into distant territory with long transmission systems within the past few years is the lowering of construction costs due to the trend toward larger diameter pipe and advancements in construction methods in general. Combined, these modern trends have pared costs somewhere in the neighborhood of 25 per cent in comparison with costs for similar projects under conditions existing three or four years ago.

The 20- and 22-inch diameter pipe lines are common now, and the trend toward larger diameter pipe continues. The next gigantic construction work will be a 24-inch gas line running from the Texas Panhandle to Chicago, Ill. Use of 22-inch pipe on a long project was first made on the Interstate Natural Gas Co.'s line from Monroe, La., to Baton Rouge. It was a coupled line using 20-foot joints. Since then several gas lines have been built with large diameter pipe, and the two big gas lines now under way—the Monroe-St. Louis and the Monroe-Atlanta lines—are being built with 22-inch pipe.

Within the period covered the 30- and 40-foot joints of pipe, especially in larger diameters, have come into more general use. Long joints were introduced eight or nine years ago on 8-inch lines, but were slow to gain favor among gas line builders. More recently, however, the long joints of pipe are being used on both coupled and welded lines.

When it was demonstrated that the longer joint accelerated stringing and did not offer any difficult handling problem, as well as reduced welding or coupling time approximately 50 per cent, they were more universally used. In addition, they were made in uniform lengths. Among the virtues of this was that by having uniform lengths it was a simple matter to remove a joint from the line as a result of a break and replace it with one out of stock.

About this period of progress, arc welded line pipe was introduced. It was made of higher carbon steel and thinner walls, which reduced weight, yet at the same time maintained a high tensile strength. This pipe was made in 30- and 40-foot lengths. Electric welding in the field made its appearance a short while later and one of the more recent welding jobs of this type was on a large diameter line from New Mexico to El Paso. Incidentally, this line gave the gas industry in America an international touch of color when the gas line was extended across the border into that colorful holdout of the thirsty, Juarez, Mexico.

Bell and spigot pipe is another of the recent introductions to line construction, and considerable work is being done with this familiar joint of pipe at the present time. Along with its introduction came the expansion joint. Fred Lege, Jr., president of the Magnolia Gas Co., and one of the pioneers in new methods, was responsible for development of this type of joint. After doing preliminary work on it he turned it over to a pipe manufacturer for completion and the joint was used in the construction of a main line by the Magnolia company.

The practice of building telescopic transmission systems on a large scale is another recent innovation. The first trunk line built with this design was built by the Magnolia company out of northern Louisiana to Beaumont, Texas. The line was welded throughout and proved successful. The same company is building a line of identical design to Dallas and Fort Worth, Texas. Several other lines have been similarly designed.

The acceptance of the long joints of pipe and the trend toward larger diameters hastened improvements in construction methods which have not only aided in lowering costs but have geared construction to a higher speed. An example is found in the Monroe-Atlanta line being built by the Southern Natural Gas Co. This system has 450 miles of main line and the 19 branches will swell the total mileage to above 900.

Construction work was started this summer and gas is to be turned into Birmingham and Atlanta by Christmas. At present the construction is well ahead of schedule. The project is reaching its peak construction period and at that time around 4,000 men will be employed.

Contractors are in a position to push construction much

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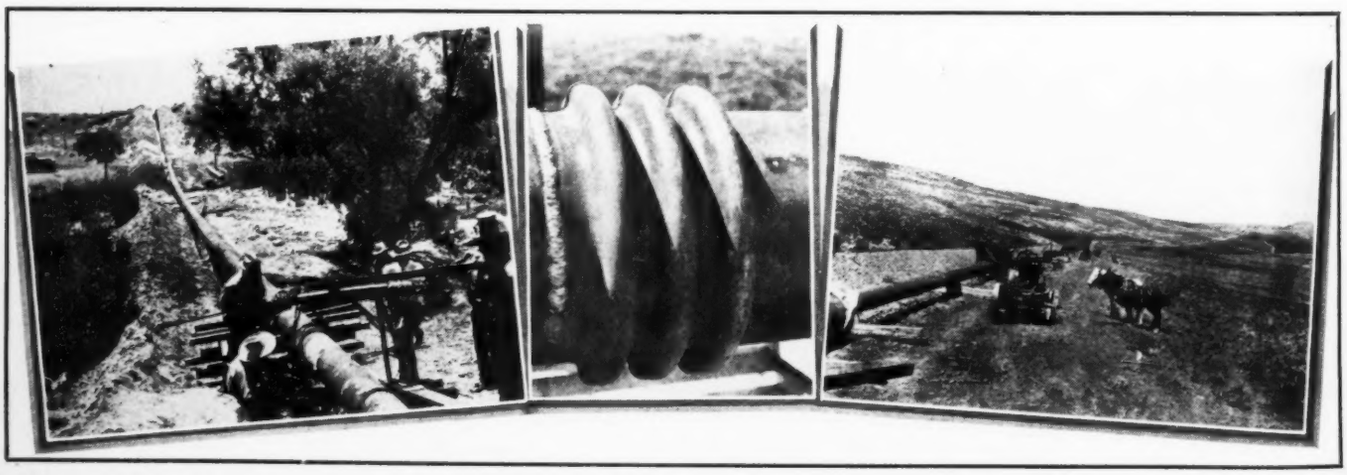
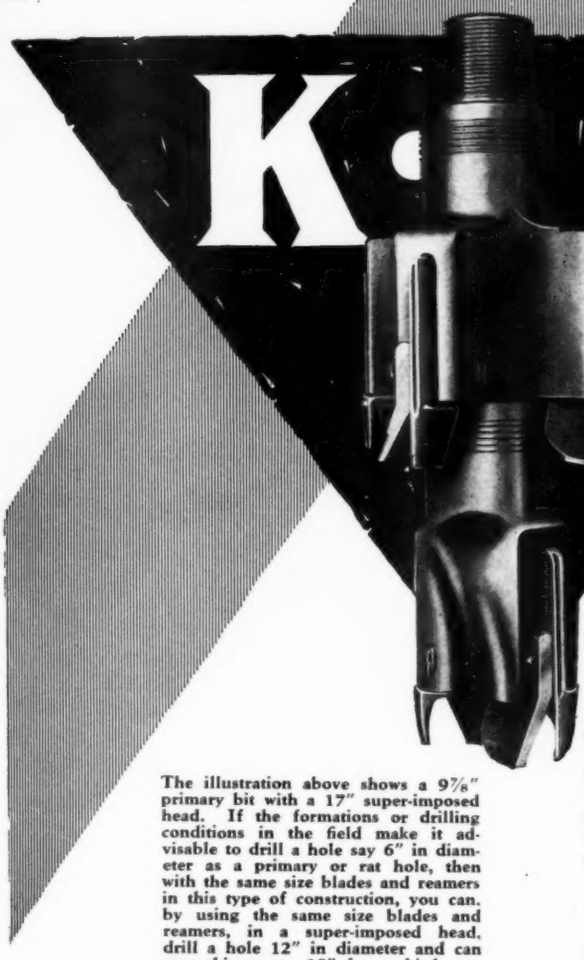


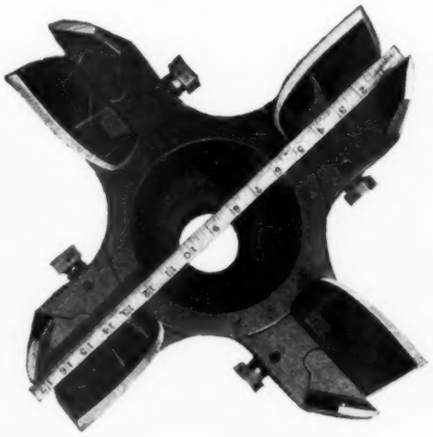
Left—Lowering the pipe on a gas line in Palo Dura Canyon, West Texas. Center—The expansion gas line joint invented by Fred Lege, Jr., president of the Magnolia Gas Co., and made by the A. O. Smith Corp. of Milwaukee, Wis. Right—Welding a gas line in Utah. (The latter picture furnished by the Lincoln Electric Co.)

A BIT OF PERFORMANCE



The illustration above shows a 9⅞" primary bit with a 17" super-imposed head. If the formations or drilling conditions in the field make it advisable to drill a hole say 6" in diameter as a primary or rat hole, then with the same size blades and reamers in this type of construction, you can, by using the same size blades and reamers, in a super-imposed head, drill a hole 12" in diameter and can step this up to 18" by a third step or by using the reaming blades only as a super bit.

The illustration below gives you the bottom view of the K-P Super-imposed Head before screwing on a regular K-P Straight Hole Bit.



One bit made 15 holes, Another seven!

Quite a bit, eh?

"The K-P bit that drilled the discovery well in the new field at Sequin, near San Antonio, Texas, has drilled *fifteen wells,*" says M. O. Brink, driller, in a letter written to John Sigmund, Contractor of Aransas Pass, Texas, on August 4, 1929.

"This well was drilled for the Texas Company from top to pay by 'Red' Connors. 'Red' has another Kennedye-Plumb bit which has made *seven wells!* 'Red' says: 'It would have taken a train-load of fish-tail bits to make as much hole as I have made with these two K-P bits. Outside of a slight cutting in the water course, these two babies are okay'."

Have You Got the Dope on the New K-P SUPER-IMPOSED HEAD?

Kennedye-Plumb, after a lot of research, as well as practical work in the field, the purpose of which was to determine just what thickness of blade would continue to cut or penetrate and still have sufficient strength to withstand the terrific shocks encountered in drilling, has put out the new "K-P Super-imposed Head". Write for circular 814 giving the low-down on it.

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SKINNER BROS. BELTING CO.

Sole Distributors of

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Nu-Way wire line Oil Savers

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Our Representatives Cover the Entire Mid-Continent Oil Fields

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faster because of the improved ditchers, right-of-way machines and the versatile boom tractors. Boom and crane tractors are familiar pieces of equipment on any line construction job and are almost indispensable now on the projects using the large diameter pipe.

The tractor has not done so much toward the elimination of manpower as it has in accelerating work. It is used in lifting pipe, lowering it into the trench, lining up and stringing. During rainy weather and in the lowlands the caterpillar tractor is utilized for motive power in places where teams could make little progress. In unloading pipe it finds another use, and almost every job presents some new and unique problem that can be solved with the tractor.

Right-of-way machines are coming into more general use. Equipped with a skimmer, the machines hurry up the clear-

Making up a river-crossing for gas line in Texas.

ing of right-of-way and at the same time make a road for the ditchers as well as for crews. It is also used to make river crossing approaches by cutting down the grade. Another of its uses is the elimination of considerable manpower in removing blasted rock from trenches. The machines are equipped for deep-ditching and are used to eliminate many bends, especially in rolling country.

Improvement in the trenching machines in the past few years has been notable. The newer types of machines are more flexible and can do much more work than the older types of ditchers.

Although small, the portable all-welded steel constructed tripod is listed among the newer pieces of line construction equipment. Its use is more in the field of repair work and in taking up old lines, but it is used on new projects.

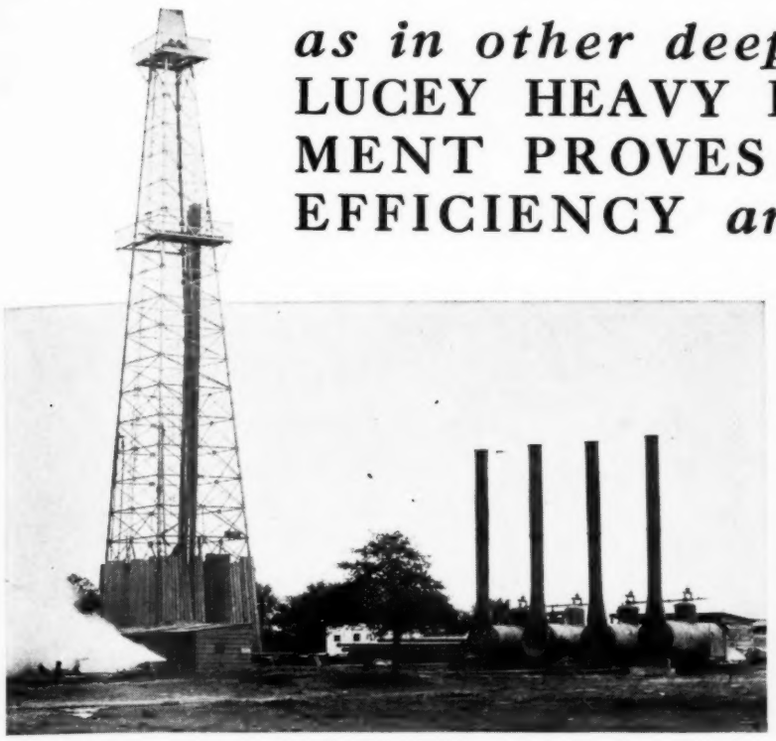
Back-filling is now done with more speedy and economical methods than formerly and the trend is toward light machines for this particular type of work. Most of this is being done with a tractor equipped with winch and slip-board.

A COMPREHENSIVE detailed list of Garlock packings, covering every conceivable type of service, is contained in an attractive catalogue put out by the Garlock Packing Company under the title of "Garlock Packing Service". Besides being well illustrated in color, each type of packing is accompanied by concise information regarding the service to which it is best adapted. The general offices and factories of the company are at Palmyra, New York.

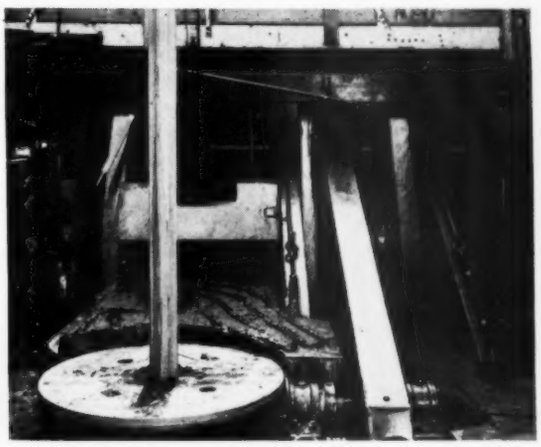
A SHALE separator, the purpose of which is to facilitate settling of the cuttings carried by the mud fluid, and eliminate the need for large settling pits at drilling wells, is now manufactured by the Brauer Machine and Supply Company, Seminole, Oklahoma. The separator is described in a pamphlet issued by this company under the title of the "Brauer Shale Separator".

AT OKLAHOMA CITY--

as in other deep-hole districts LUCEY HEAVY ROTARY EQUIPMENT PROVES ITS STAMINA, EFFICIENCY *and* ECONOMY—



View of I. T. I. O. Waters No. 1, 25-11-3 Oklahoma City, drilled with Lucey heavy rotary equipment.



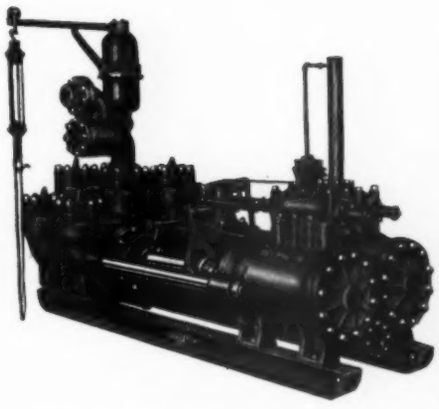
Fred Foster, drilling superintendent for I. T. I. O., and Elmer Martin, driller.

LUCEY
"WHEREVER THERE'S OIL"

One of the first wells to be put down in the Oklahoma City district was the Indian Territory Illuminating Oil Company's Waters No. 1, in 25-11-3. This well was equipped with a complete Lucey heavy rotary outfit and its consistent, reliable performance which has distinguished Lucey Equipment for years in deep-hole drilling won favorable commendation from the contractors, Mandeville and Thompson of Chickasha and Tulsa, who also operate several other Lucey outfits.

Engineering tests to determine the deflection of the hole showed that at no time was it more than 2½° off vertical.

Lucey "Old Reliable" slush pumps are playing an important part in developing Oklahoma City deep-well production. Mr. Foster states that his "Old Reliable" drilled to a depth of 4500 feet with the original equipment and absolutely no renewals of any kind.



"Old Reliable", 15"x7¾"x18". Plenty of reserve pep and power.

LUCEY PRODUCTS CORPORATION

New York, 3505 Woolworth Bldg.
Tulsa, 224 E. Brady St.
Los Angeles, 5043 Santa Fe Ave.
Shreveport, P. O. Box 116.
Houston, P. O. Box 609.
London, 54 Old Broad St., E. C. 2.
Paris, (1er) 55 Rue de Rivoil.
Healdton, Oklahoma.
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Houston, T. T. Word Supply Co.
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Ft. Worth and Wink, Hercules Supply Co.
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Wichita, Bridgeport Machine Co.
Casper, Wyo., Champion Supply Co.
Los Angeles, The Oil Well Equipment Corp.
San Fernando, Trinidad, B. W. I.
Ploesti, Roumania.

BIG LAKE WAS FIRST FIELD *to Have*

Complete Electrical Equipment

BIG LAKE FIELD in Regan County, Texas, is one of the most picturesque in the oil country and is unique in many respects. Prominent among its features is the fact that Big Lake has the distinction of being the first 100 per cent electrically operated pool in the world.

It claims another record in having the world's deepest oil well which is producing about 2,800 barrels of 56 degree gravity oil daily from a total depth of 8,523 feet. For a while it held the deep hole record, but in these days of tottering endurance records, that achievement fell when the Shell Corporation went below 9,200 feet with a hole in California. Big Lake is generally credited with being the pool leading to the discovery and development of the broad, arid and sandy West Texas area, and according to oil field lore, its discovery was more or less of an accident.

Its main producing horizon is in a lime zone found around 3,000 feet, although some production is being recovered from a 2,400 foot zone. The oil is light, containing less than a half per cent sulphur and is produced with gas containing hydrogen sulphide. Two producing companies own the entire field and incidentally one royalty owner, The University of Texas, owns all of the royalty. Consequently development has been slow and orderly with the exception of a short-lived line fight during early stages of the field. Since then, production has been held fairly constant around 18,000 barrels daily and the Big Lake Oil Company, major producer in the pool, still has about one-third of its development campaign in the 3,000-foot zone to complete.

Transformer banks in the Big Lake field.

A little more than two years ago there was evidence of the field's gas pressure diminishing at a rapid rate and the Big Lake Company started looking to its future pumping problems. From the start gas engines operated at a disadvantage because of the extremely bad water conditions, and the sulphur saturated gas.

When electric motors for pumping were installed, all of the 112 pumping wells were producing from the 3,000-foot zone. Levi Smith, president; E. C. Stearns, general manager; J. S. Posgate, engineer, and C. R. Johnson, general superintendent, completed plans for the change-over on May 7, 1927. Ten weeks later, F. B. Shepard, chief electrician, had motors running and a few days later all of the 112 wells were being pumped with electric units.

Changing over was no small task and the speed made is more remarkable because of the pioneering work in connection with the job. At the time, 12 miles of 13,800-volt power line and 16 miles of 440-volt distribution line had to be constructed. In addition all of the engine houses had to be torn down and rebuilt. A system cutting down the shut-down time of each well to two hours was worked out for cutting over to electric power. Arrangements were made to make it simply a matter of disconnecting from the gas engine clutch and putting belts on the counter shafts for the motors.

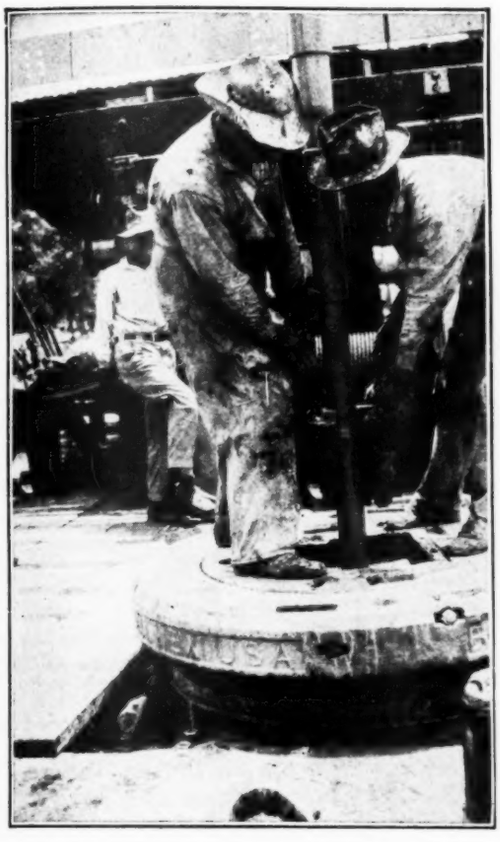
High lines coming into the field carry 66,000 volts, which is stepped down to 13,800 volts at the main transformer bank. This voltage is stepped on down to 440 volts at the smaller transformer stations to operate both the pumping

(*Turn to Page 210 please*)

McEVOY UNIVERSAL

CASING AND TUBING CONTROL HEADS

Meet Every Need of the Top of the Well From "Drilling in" to Pumping



Texas Company's Landslide 263, Humble, Texas

E. T. Junkins, Driller (background); Herman L. Koinm; U. L. Bass; A. L. Wilson was also a part of the crew.

*While your well is drilling, **McEvoy Safety Pressure Head** is used as illustrated to keep the well under control; after the well is completed, slips, body cap, and stuffing box are mounted and the well is still kept under control while flowing through tubing or larger size pipe.*

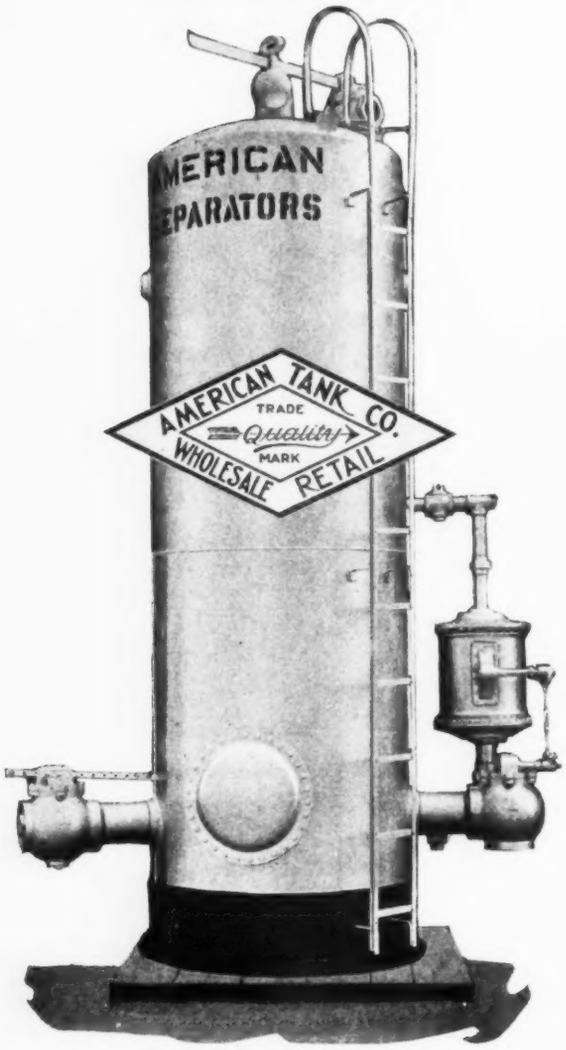
J. H. McEVOY & COMPANY

HOUSTON, TEXAS, U.S.A.

Pacific Coast Branch: McEVOY SCREEN PIPE CO., 2428 E. 56 St., Los Angeles, Calif.

AMERICAN
OIL AND GAS
SEPARATORS

Sturdy, Dependable and Efficient



COMPLETE STOCKS

ELDORADO, ARK.
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BIG SPRING, TEXAS

"Complete Tank Service for the Oil Industry"

AMERICAN TANK COMPANY

OKLAHOMA CITY

Sales Offices:

Tulsa and Fort Worth

and drilling motors. At the present time 165 wells on the Big Lake Oil Company's leases are producing on the pump and each well represents an individual problem in working out details for the greatest efficiency. The pumping motors are 15-35 horsepower, operating on the low side for pumping and the high side for pulling rods and tubing or cleaning out. Each well is equipped with a separate motor.

Motors are connected to the countershaft with a belt and the shaft in turn is connected to the band wheel with a belt. The most advantageous length stroke is selected and ranges anywhere from 24 to 54 inches, depending on the amount of fluid to be lifted. Pumping is made more difficult in Big Lake because of the amount of water to be lifted, which ranges anywhere from 50 to 75 per cent of the fluid handled. Average production of the wells is 80 barrels of oil daily.

Great pains are taken to arrange the pulley ratios to have the motors operating on the eighth or ninth point of the controller. This is done with a view to obtaining the greatest efficiency. The average well pumps with 15 to 18 strokes per minute.

Some of the wells are equipped with 3-inch tubing and 3-inch working valves, while others are equipped with 2-inch tubing and valves, depending upon the size of the well. One of the claims for the motor is, it permits more accurate balancing of the wells, thereby eliminating considerable rod trouble.

On an average, 750 kwh per day are consumed in digging a 3,000-foot well with cable tools during a full 24-hour day. The power costs 1.4 to 1.5 cents per kwh.

For a protection against the attacks of sulphur gas on the equipment, the parts more likely to be damaged by corrosion are plated with cadium or zinc. All shunts on controllers, brushes and pig tails are protected in this manner.

Maintenance of the equipment is one of the major items in economic operation. A small air compressor driven by a motor and mounted on a truck is the main piece of equipment used to keep the machinery free from sand and dust. The crew operating this usually visits each well once a week. The compressor motor taps in on a service switch and the compressor blows out the sand and dust in the windings and controller parts. The production department figures this item of maintenance has reduced upkeep from 25 to 30 per cent. This type of maintenance work is being done generally in West Texas where motors are used for prime movers.

Portable power banks have been designed for use in drilling wells outside the limit of the regular power lines. Transformers are set up on wagons with steel wheels which are anchored close to the drilling operation. Lines are then extended and the work started.

The permanent transformer banks have been built to afford ease in moving the transformers. Each one is set up on a frame foundation built to the height of a truck bed and surrounded with a heavy wire fence. If the transformer has to be replaced a substitute is moved up on a truck and skidded on to the bank platform.

Texon Oil & Land Co., the other producer in the pool, has 64 wells pulled by motor and 12 on a central power unit. The same type of equipment is used as that on Big Lake Oil Co. properties except that Tex-Rope drive is used instead of belt drive. This company is using two rewound 25-65 motors on two wells where there is a heavy overload of water.

The pump strokes on these leases range from 20 inches to 6 feet and the average stroke is 4½ feet, according to Waldo Williams, engineer. Average production per well is 40 barrels of oil and 93 barrels of water.

When writing AMERICAN TANK COMPANY *please mention The Petroleum Engineer*

Sucker Rod Factory *Has Largest* NORMALIZING FURNACE

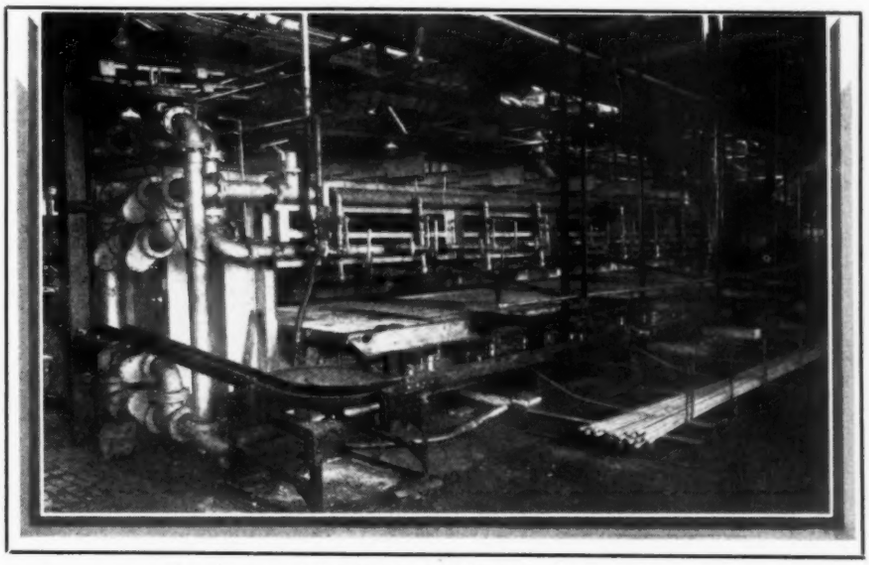
IT is probably hard for many people now engaged in oil field activities to realize that up to 1893 all pumping wells were equipped with wooden sucker rods. The standard size for 2-inch tubing was a 1⅝-inch rod with boxes and pins riveted to the rods through strap iron.

The first successful steel sucker rods were manufactured in the same year, 1893, and, although numerous experiments had been made in manufacturing iron rods by attempting to weld a box and pin on the rods, the efforts were unavailing on account of the cost of machining the boxes and pins, then hand welding them on to the bars. So, the first successful rod was the Acme sucker rod, which was not a welded rod, the joints being made by inserting the bar in malleable sleeves and then upsetting the bar in the sleeve. These Acme rods have been made continuously for thirty-six years and many millions of feet have been and are being used in the shallow (up to 2500-ft.) wells of the world.

As wells became deeper many problems confronted manufacturers of sucker rods as well as the manufacturers of other oil well equipment, but the sucker rod manufacturer had a more serious problem than equipment manufacturers whose material went on top of the ground, as the sucker rods could not be increased in weight and diameter to take care of excess loads, and improvement had to be made in the bars themselves and the methods of manufacture, and still keep the diameters down to the standard ⅝-inch, ¾-inch and ⅞-inch sizes.

The greatly increased depths and crooked holes resulted in the adoption of better grades of steel and the upset box and pin on the rods. In all the processes of development, in order to take care of the extremely heavy loads placed on the small bars, sucker rod manufacturers have been in every way attempting to get steel that would stand up, improve forging methods to prevent distortion, etc., and have been looking forward at all times to be able to provide methods that would take care of the increasing loads. Up to the present time the manufacturers have been quite able to meet the severe conditions imposed upon them, and the practical limit has been reached in using steels without heat treatment. But to be able to provide for depths beyond which we are now going and for unusual wells, now heat treatment is a probable necessity. This problem has been considered and faced for years and many abortive attempts at approaching heat treatment have been used, such as normalizing the rods in the upset portion and heat treating the ends only. The great difficulty attendant upon heat treating full length bars was the necessity of keeping the rods straight in going through a heat treating furnace and during the process of cooling, quenching, or drawing.

The S. M. Jones Company, after five years of experimental work, have caused to be designed and erected the first and largest slot type sucker rod normalizing furnace in the world in which it is now possible to fully normalize full length 30-foot sucker rods. This is the most radical departure in the history of the manufacture of sucker rods since the change from wooden rods to iron, and this move has been watched with a great deal of interest by metallurgists, production engineers, and field men who have been constantly on the lookout for the best possible sucker rods to meet the strenuous work that is now being imposed upon them.



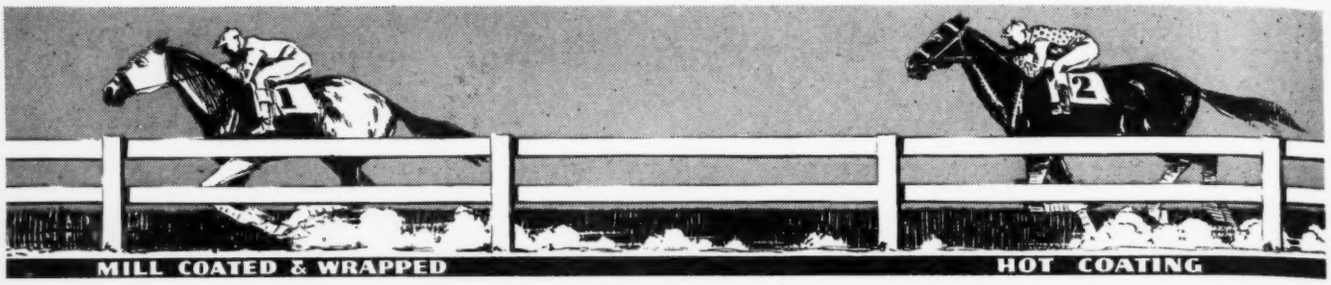
New furnace of S. M. Jones Co. for normalizing sucker rods.

In order to provide for the installation of this enormous furnace, The S. M. Jones Company have entirely rebuilt their shops, provided new and additional machinery and now claim to have the largest and most complete equipment for the manufacture of sucker rods. An interesting and unusual development has been the installation of "on the line" methods as employed in the automobile factories. The sucker rod bars coming off the cars at one end of the shops, going through the various forging processes, normalization, then threading and inspection departments and on to the cars, a finished product, traveling always in the same plane.

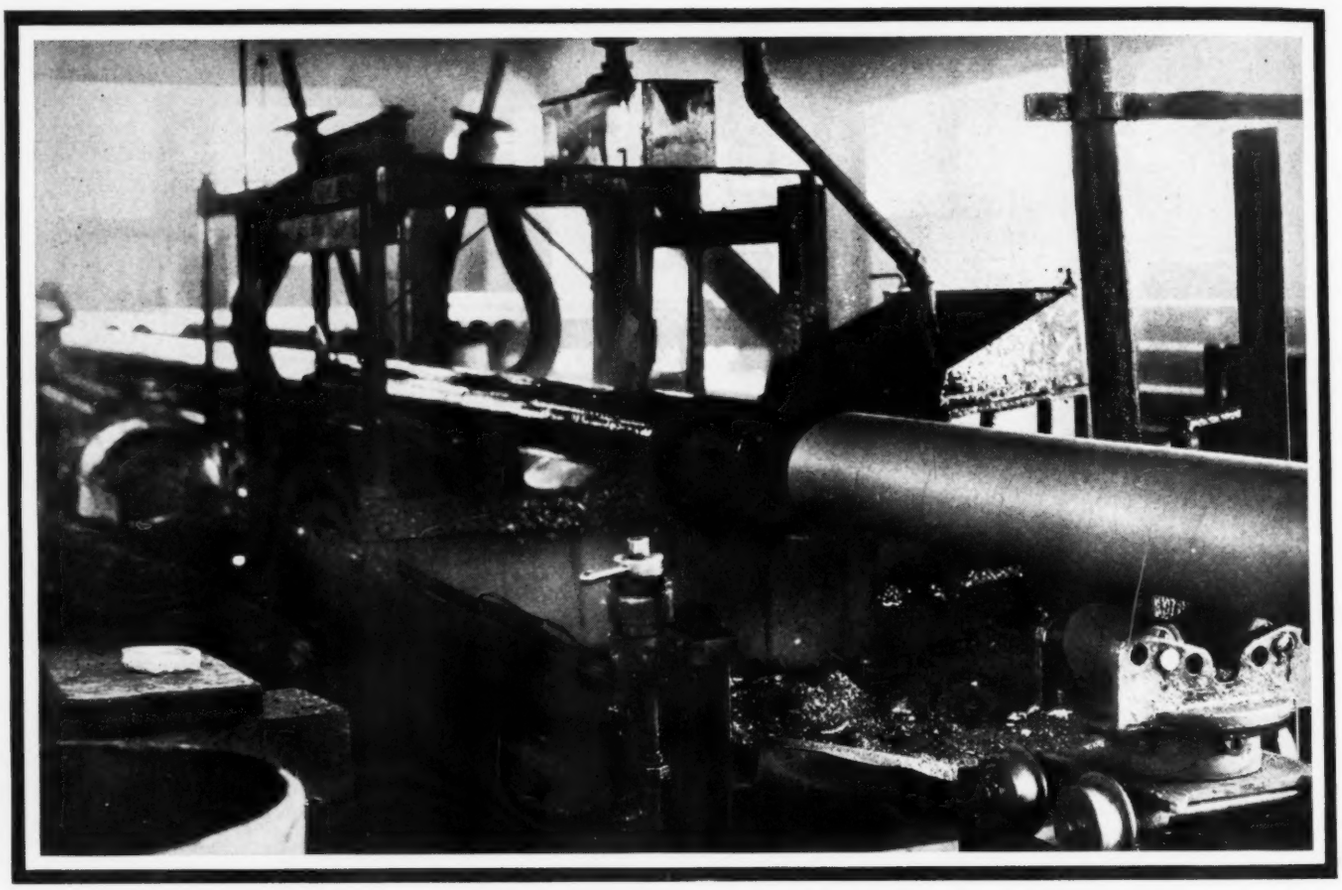
The entire process of manufacturing Jones Sucker Rods has proven so interesting to many engineers and field men that the company cordially invite interested users of sucker rods to visit the plant.

THE Babcock & Wilcox Tube Company, Sales Offices New York City, has issued Enduro KA2 Steel, an introduction to the steel produced under Krupp patents. The numerous applications of the metal and its resistance to corrosion and its high temperature applications are illustrated and described. Of particular interest to the refiner is its outstanding use in tubes for high pressure cracking stills.

Enduro KA2 Seamless Tubes and Pipe, its physical and chemical properties and its working qualities, are described. The effect of high temperature on the physical properties is graphically illustrated.



ONLY 1 YEAR



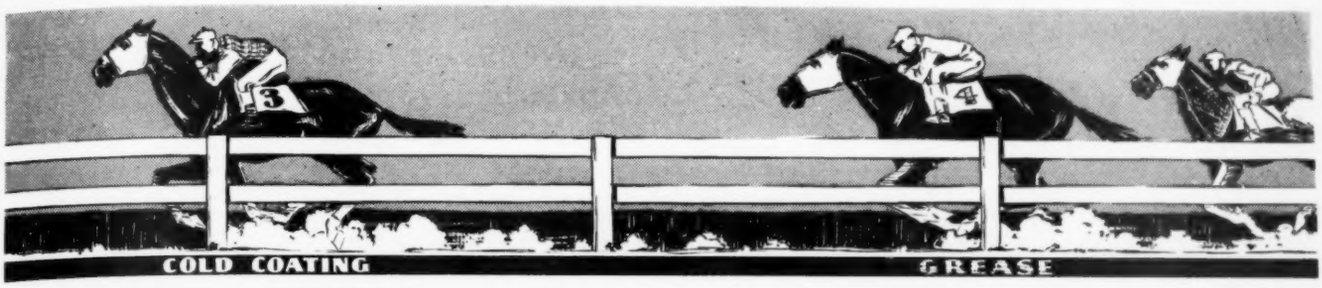
The photograph above shows the coating and wrapping machine at one of the largest pipe mills in America. Six plants operated by Hill, Hubbell & Company, throughout the country, at as many pipe mills, are applying coating and wrapping to many miles of pipe, under contract. The method of application is as follows: After being cleaned and primed under scientific control, the pipe is fed into the coating and wrapping machine in a continuous length, using temporary couplings. As the pipe is passed through the machine in a spiral motion it receives in succession two hot coats of enamel, a wrapper of felt, and a final wrapper of kraft paper. The kraft is applied for the purpose of furnishing a light surface which acts to deflect sunrays while the pipe is in transit to its destination. The contrasting light kraft surface and the dark felt underneath also quickly spot any damage that may have occurred to the wrapper in transit. Only careful and intelligent handling is required to prevent damage to the coating and wrapping, as our records covering hundreds of carloads of pipe transported in this manner have shown.

HILL, HUBBELL

Division
General Paint Corporation
Manufacturers of Highest Grade Oil Industry Paints and Pipe Line Coatings

Offices: SAN FRANCISCO TULSA NEW YORK CHICAGO

When writing HILL, HUBBELL & COMPANY *please mention The Petroleum Engineer*



OLD .. but already away out in front.

EXACTLY one year ago this month, (October, 1928) we announced a revolutionary advance in pipe protection—MILL COATED AND WRAPPED PIPE. In our announcement we said, "Hill, Hubbell & Company, originators of nearly every improvement made during the past fifteen years in materials and methods of applying pipe coatings, take pride in announcing machine coated and wrapped pipe .... the revolutionary effects that machine coated and wrapped pipe will have upon the Industry are apparent because of the many advantages over present-day methods of application."

Today, (October, 1929) more than three thousand miles of pipe have been mill coated and wrapped by Hill, Hubbell & Company's mechanical application. It is a significant fact that the leading pipe line companies have specified mill coating and wrapping for the largest pipe line projects of the past twelve months. The foremost pipe line engineers of the country are unanimous in their opinion that the absolute temperature control of the coating and the precision made possible by mechanical application greatly prolong the life of pipe. It is universally agreed by experts that the proper application of the coating is the largest single factor in the success of any form of protection of buried pipe against corrosion and soil stress.

Booths 38-39
Texas Building

We cordially invite your investigation of the facts concerning mill coated and wrapped pipe—facts that have led to its almost instantaneous adoption by the leaders in the Pipe Line Industry as the outstanding methods of pipe protection.

& COMPANY

General Offices: SAN FRANCISCO
Mid-Continent Factory: TULSA

LOS ANGELES HOUSTON PORTLAND SEATTLE SPOKANE

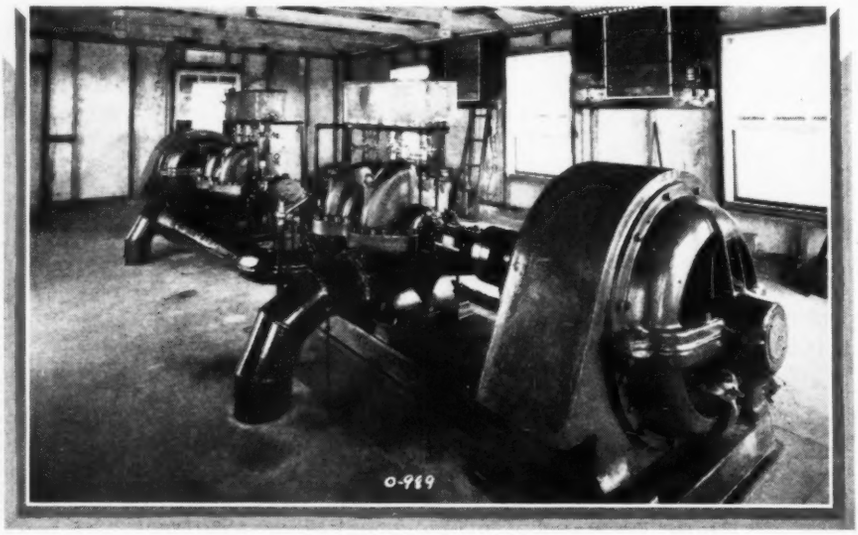
When writing HILL, HUBBELL & COMPANY *please mention The Petroleum Engineer*

Pipe Line Systems find

Portable Units Good *in* Booster Work

TO cut down the expense of heavy investments for stand by units in its booster stations on an 8-inch line from Hewitt station in southern Oklahoma to De Queen, Ark., the Oklahoma Pipe Line Co. designed a portable main line booster station, probably the first of its kind in oil transportation history.

Initially this line handled 20,000 barrels daily through the one 8-inch line. At that time station equipment consisted of two oil engines driving plunger pumps. Later on it was desired to increase the delivery of oil to 32,000 barrels daily without building additional line.



Byron-Jackson motor-driven centrifugal pump in the Seminole field.

Capacities of the main line stations were boosted by cutting the size of the plungers and running two units together. A third oil engine unit was installed for a standby. Power lines were close to the booster station sites, and for that reason motors were selected for prime movers at these stations. These motors are 400-horsepower synchronous motors driving plunger type pumps.

When the time arrived to make a provision for a possible time-consuming breakdown or shutdown for overhauling, engineers had their choice of three standby installations. One was the duplication of the motor-driven unit; installation of oil engine units and using the electric-driven units for a standby, or the building of a portable unit. After making a careful analysis of costs, operating charges, etc., the portable centrifugal unit was decided upon.

Mobility of these units had been demonstrated to the operating departments several months previous. A disastrous fire destroyed one of the motor-driven plunger pump stations, and to get the line operating as quickly as possible at capacity it was decided to move the equipment from an idle booster plant in the northern part of the state to the still smoldering site of the destroyed station.

While crews labored to clear away the debris from the burned site another crew with trucks was dispatched to the northern part of the state to dismantle and move the centrifugal unit. Seventy-two hours later that unit was in operation on the southern end of the company's main line system.

The portable unit was designed to handle both light and heavy oils. In its entirety, including the building, it can be moved on five heavy duty trucks. The gross weight of the entire assembly totals 37,000 pounds and can be moved to any point along the line within 48 hours.

Motors and the starting equipment weigh 10,200 pounds and the two pumps, base plates and couplings weigh 18,000 pounds. The steel frame and sheet metal housing weighs approximately 8,200 pounds. The building is the knock-down sectional type and none of the equipment offers any great difficulty in loading or unloading.

Station equipment consists of two 6-inch five-stage multiplex heavy-duty centrifugal line pumps. These are directly connected with flexible couplings to a couple of 300-horsepower, 2,200-volt, 3-phase, 60-cycle motors. The motors are automatic compensator controlled, using oil-immersed contractors.

Pumps are arranged in series and have been designed to discharge a maximum delivery of 32,000 barrels of light oil daily, against a maximum pressure of 750 pounds. They are equipped with a 2-inch by-pass between the suction and discharge to control operating characteristics in addition to being controlled by means of the header gate. Switchboard equipment is composed of a center panel for the incoming line with circuit breakers on either side. To the right and left of this panel are the starting compensators. The transporting company has its own metering and measuring equipment on the incoming line panel.

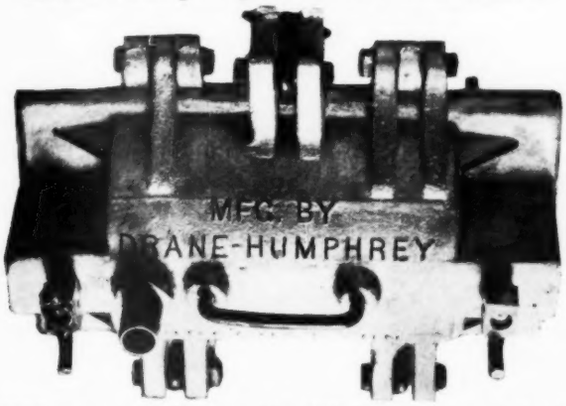
The steel frame and sheet iron building is so constructed that it can be knocked hurriedly and erected with a minimum of skilled labor. Its dimensions are 26 by 30 feet and it can be moved either in sections or torn completely down. It is fool-proof in construction, easily erected by having reversible ends and the opposite sides can't be erected wrong because they are duplicate panels. The building is 100 per cent salvageable except the sheet fasteners.

Foundations for this portable unit have been laid at the booster stations with reference to power lines. Oil lines were extended to the concrete foundation, gates installed and the flanged end of the suction and discharge lines plugged. The power wires likewise were brought up and dead ended.

Bed plates are planed and set on bearing channels. When the station is to be moved all that is necessary is to break the couplings, unbolt the flanges, move motors and pumps from bed plates, unbolt the bed plates and move the units. The switchboard equipment also can be moved with ease.

With this equipment the company has a minimum figure invested in auxiliary units and is prepared for an emergency at any one of its booster stations. It likewise is equipped to move in whenever necessary while regular booster station equipment is being overhauled.

Drane-Humphrey Has New Lubricator



THE advent of the new No. 269 Lubricant and the D-H Lubricator makes successful wire line lubrication an actuality and no longer a theory or an experiment, according to the Drane-Humphrey Co.

The D-H Lubricator applies No. 269 Lubricant in a manner that eliminates all waste of both time and material. It cleans the line and applies the lubricant in one operation—and what's more, it is so constructed as to permit of the removal of all the unused lubricant in the machine. No. 269 Lubricant is a radical departure from all previously tried materials for this purpose.

This lubricant has the property of forming a surface film over the entire rope thus preventing the evaporation of the highly penetrating lighter oils contained in this compound.

The lubricant is *insoluble* in any refined or crude petroleum products, water or any alkaline solution which might be encountered in drilling operations.

WHERE high gas pressures are encountered, it is essential to have control of the well at all times, to safeguard against any serious accidents and the possible loss of the well. For this purpose the Baker Combination Drilling Valve and Blowout Preventer was designed. It is combined in one compact unit. Further detailed information is contained in a pamphlet containing excellent cross sectional cuts of this fitting for wells in high pressure areas put out by the Baker Oil Tools, Inc., 2951 East Slauson Avenue, Huntington Park, California.

A DISCUSSION of what Portland Cement is and what takes place when cement sets is discussed in "Why Is Portland Cement Used in Oil Wells?" the title of a pamphlet issued by the Sullivan Company of Texas, Chemical Specialists, 1201 Post-Dispatch Building, Houston, Texas. Water ratios in concrete, hydrated lime vs. Konset, and Konset vs. calcium chloride are also covered in interesting detail, especially as it pertains to the use of cement in an oil well.

A NEW booklet has just been issued by the Landis Machine Company, Waynesboro, Pennsylvania, describing the latest improvements in their forming, threading, and cutting machines. The title of the booklet "Threading Specialized" covers the various phases of pipe cutting and threading met with in the oil fields and points out the economies that are possible by the use of good equipment.

THE Brauer Hydraulic Wall Hook, designed for use in fishing jobs where the pipe is leaning against the wall in a cave or enlarged part of the hole has recently been put on the market. A detailed description is given in a pamphlet put out by the manufacturer, the Brauer Machine and Supply Company, Seminole, Oklahoma.

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. . . . Have a cool supply of clean-pure sparkling water... ready to drink at all times. No matter where you are the GOTT Water Can is health insurance. Your supply store has them.
Gott Water Cans 1½ gal; 3 gal; 5 gal; and 10 gal.
Gott Water Coolers 3 gal; 5 gal; 8 gal; 10 gal; and 20 gal.
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Keep Pure Water Always Handy

H. P. Gott Mfg. Company

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to inspect the COMPLETE PARKERSBURG RIG erected by our company, which will be displayed at the International Petroleum Exposition.

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in Oil Drilling and Production Equipment?

Every deep well record made in the Gulf Coast area has been made with the Dreadnaught Water Cooled Brake Flange Draw Works. Depths well below 7500 ft. are easily and quickly handled with no overheating of brake rims or brake lagging. Full speed operation at all times.

These remarkable and revolutionary drawworks are only one of the *Dreadnaught Units* being built for the oil industry. Other units include Straight Line Crown Blocks, Traveling Blocks, Tubing Blocks, Structural Steel Walking Beams, Pumping Counter Weights, Pumping Hoists, Rotary Slips, Tubing Spiders, Tubing Tongs, Drill Collars, Drive Shoes, Pumping Jacks Anchor Clamps, etc.

No matter where you are operating

Dreadnaught Equipment

will render enduring and satisfactory performance.

Complete details covering any Dreadnaught Quality Equipment gladly sent. Let us have your inquiries.

Sold by Your Dealer; Any Frick Reid Store or Direct

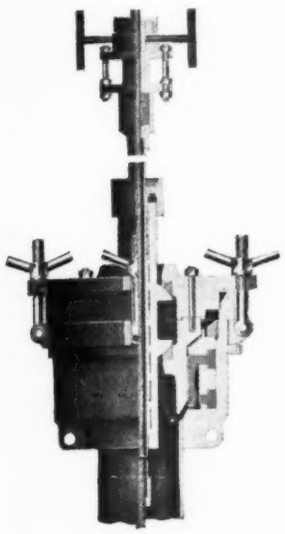
BEAUMONT IRON WORKS COMPANY

Beaumont, Texas, U. S. A.

When writing Beaumont Iron Works Co. *please mention The Petroleum Engineer*

Kerotest Has New Oil Saver

TABLE tool drillers who have had difficulty in drilling oil and gas wells under high pressure will be interested in the new Kerotest High Pressure Oil Saver, which is claimed by the manufacturer to have already saved many West Texas and Canadian oil operators thousands of dollars by conserving the large quantities of oil and gas ordinarily lost in high pressure wells.



This Kerotest device consists of a patented ball and socket, forged steel swivel mounted in a cast steel main housing. The higher the pressure the greater force is exerted to maintain a tight seat on the swivel joint. In addition the swivel joint is so designed as to maintain the cable in perfect alignment at all times, saving the wire line from wear.

The cast steel main housing is equipped with a specially designed oil resisting, packing ring which is held firmly in position by means of bronze lock rings.

It is so designed as to permit the well pressure to be actuated behind the rubber packing ring. Any increase in the oil or gas pressure automatically produces a greater pressure on the rubber packing ring.

Literature and full information will be sent by the Kerotest Manufacturing Company of Pittsburgh, Penna., upon request.

* * *

Grant Oil Tool Co. Develops New Reamer

THE Grant Oil Tool Co., of Los Angeles, Cal., holds patents on new rotary expanding under-reamers which are made in standard types for all general requirements, shale, rock, and combination, as well as in special types to solve individual under-reaming problems.

This new reamer is called the type "C," and the maker claims that its design gives it more cutting edge than any other roller-type under-reamer. The cutters cannot fall out, as they are rigidly supported at both ends with only one-eighth inch clearance between them and bottom of the cutter holders. The cutter assembly is easy to change.

The progress of the Grant Oil Tool Co. is such that a new addition to the present plant was recently completed. This addition is one of a series being planned.

* * *

"THE Story of Controlled Drilling," is the title of an interesting booklet that has just been put out by the Doheny Stone Drill Company of Los Angeles, Calif. In addition to describing the Rotary, Draw Works, and Steam Engine, which make up the Hydril drilling equipment, it discusses the positive weight control and uniform feed of the bit obtainable with Hydril equipment. A packed head, which is standard equipment, permits of perfect control of the well in the highest gas pressure areas without the use of weighted mud fluid.

A New **CF** *for*

Back Pressure Regulation in Gasoline Manufacture

IF YOU wish to hold back any pressure between 300 and 800 lbs.—and have a *continuous* discharge

(a) into a distributing system having close to atmospheric pressure, or

(b) against a back pressure slightly lower than the pressure to be controlled—

or if an auxiliary pressure for operation of the regulator is desired—

we recommend the FULTON BACK PRESSURE REGULATOR (Pilot Valve Type for High Inlet Pressure).

Every gasoline plant can employ this Regulator to great advantage. It is also available in a type that provides for intermittent discharge.

The CHAPLIN-FULTON MFG. CO.

28-40 Penn Avenue
Pittsburgh -:- Penna.

Have You Any Interesting Petroleum Industry Pictures?

FOR use in the Pictorial Petroleum Section, which will run as a monthly feature, The Petroleum Engineer desires unusual and interesting photographs. These may be of field scenes, new installations, new hook-ups, individuals, or, in short, any subjects likely to appeal to men in the petroleum industry. Especially do we desire pictures of "old timers" who are still active in the business and views with a foreign setting.

If you have such photographs, we shall appreciate your permitting us to reproduce them in our pictorial section. Extreme care will be exercised in handling them and they will be returned in the same condition as received. Kindly address photographs to—

THE PETROLEUM ENGINEER

Exchange Bank Bldg. Tulsa, Okla.

Announcing Latest Developments

THREE WRAPPERS

THE Dearborn Chemical Company is now in a position to furnish three classes of wrapping materials.

(1) Our fabric NO-OX-ID-IZED wrapper which has been on the market and proven its worth under a wide range of conditions.

(2) An asbestos felt impregnated and coated with NO-OX-ID, gray in color. This wrapper has been adopted after several years of service underground in most severe conditions.

(3) A fabric chemically treated, saturated and coated with the same gray NO-OX-ID as the asbestos wrapper.

NO-OX-ID "G" APPLIED COLD

Two new consistencies of NO-OX-ID, "G" and NO-OX-ID "G Special".

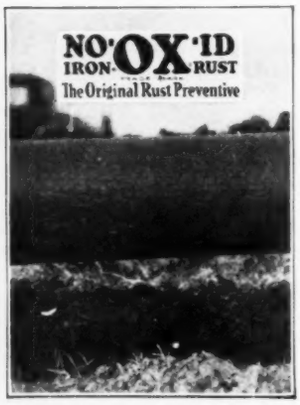
They make application without heat possible at ordinary temperatures, reducing labor and equipment needed and lessening fire hazards, giving a more dense body as a coating and material that will thoroughly wet the metal surface and keep it wet with NO-OX-ID over a long period of time.

* * * * * *

Dearborn methods are positive proven methods and Dearborn service men are in the field servicing pipe line jobs. Engineering service is furnished to determine proper application under specific conditions.

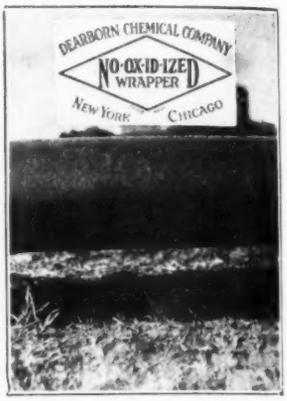
DEARBORN CHEMICAL COMPANY

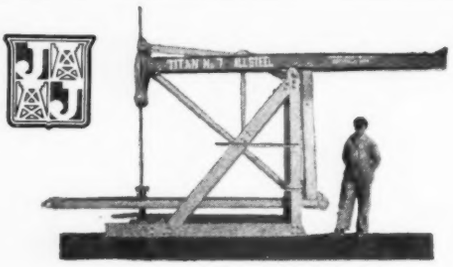
310 S. Michigan Avenue, Chicago Canadian Offices and Factory: 2454-64 Dundas Street, West, Toronto 205 East 42nd Street, New York



Pipe coated with NO-OX-ID. Center illustration shows application of NO-OX-ID-IZED

Wrapper in hand wrapped spiral. Illustration to right, the finished line ready to be lowered.





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CLEAN absorption oil is as essential to the functioning of a natural gasoline plant as clean blood is to the maintenance of a healthy, vigorous body.

The MIST-D-FIER, a new departure in scrubbers, is built to keep the oil clean, and *does* keep the oil clean.

It has dirty work to do and is built accordingly — sturdy enough to stand any pressure it may be subjected to. Built for all capacities.

Bulletin No. 6, just off the press, tells the whole story of the MIST-D-FIER. *Send for your copy today.*

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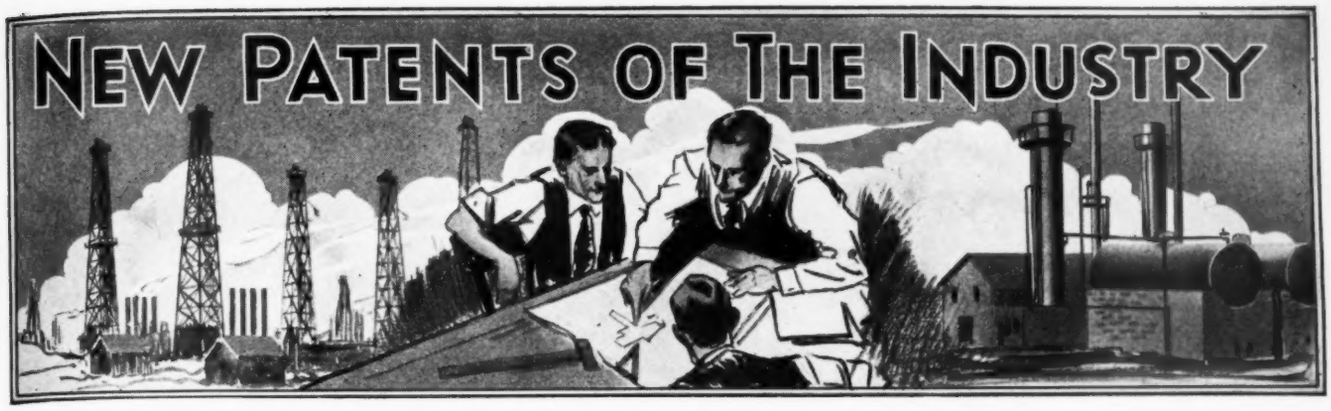
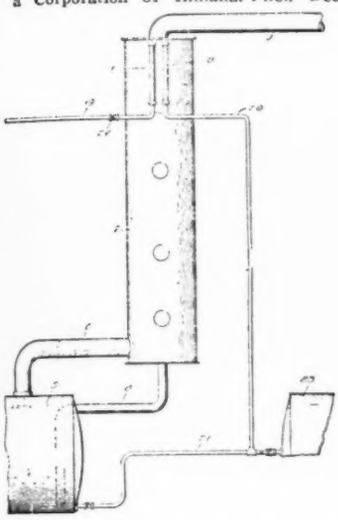
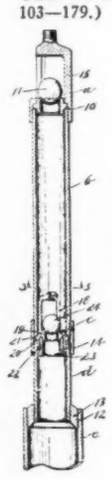


1,723,698. DISTILLATION OF HYDROCARBON OILS. WILLIAM W. HOLLAND, Alton, Ill., assignor to Standard Oil Company, Whiting, Ind., a Corporation of Indiana. Filed Dec. 11, 1924. Serial No. 755,282. 2 Claims. (Cl. 196—72.)



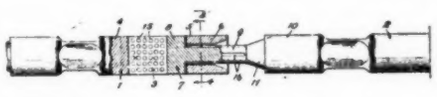
1. In the art of distilling hydrocarbon oils, subjecting the vapors rising from a distilling body of oil to partial fractionation, passing the partially fractionated vapors in indirect heat conductive contact with a current of steam at a temperature of 220 to 240° F., thereby, heating the steam and partially condensing the vapors, returning the condensate thus formed to the still in countercurrent to the vapors rising therefrom, and passing the heated steam into direct contact with a distilling body of oil.

1,726,052. OIL-WELL APPARATUS. JOHN A. YERKES, Long Beach, Calif. Filed Apr. 13, 1926. Serial No. 101,842. 2 Claims. (Cl. 103—179.)



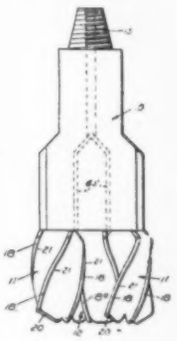
1. Improvements in well apparatus, including a pump barrel having a lining, a plunger in the barrel slidably fitting within the lining, a reducing nipple at the upper end of the plunger, an extension of reduced bore connected to the nipple and projecting above the upper end of the plunger, a macaroni tube having a bore similar in size to the extension bore, a collar connecting the macaroni tube to the upper end of the extension, a blind valve clamped between the macaroni tube and the extension by the connecting action of the collar, and a working valve carried at the upper end of the macaroni tube.

1,725,842. METHOD OF MAKING DRILLING JARS. PAUL ARBON, Tulsa, Okla.; Fidelity National Band and Trust Company, Kansas City, Mo., and Lorne M. McLeod, Tulsa, Okla., executors of the estate of said Paul Arbon, deceased, assignors to Paul Arbon & Company, Tulsa, Okla., a Corporation of Oklahoma. Filed June 2, 1925. Serial No. 34,365. 7 Claims. (Cl. 76—101.)



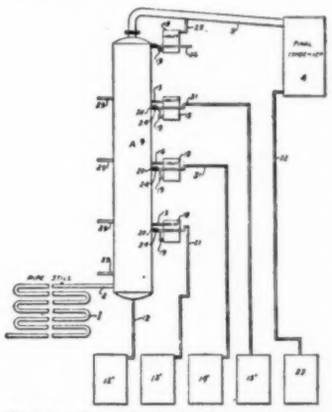
1. In the production of drilling jars, machining two work pieces all over to remove surface defects, then forging the work pieces to provide a socket section and a stem section, then annealing said sections to soften them sufficiently to be easily machined, and then oil-hardening the sections to bring the steel to maximum hardness.

1,726,049. BIT. JAMES H. SIFT, Huntington Park, and LLOYD DALLDORF, Southgate, Calif. Filed May 3, 1926. Serial No. 106,541. 11 Claims. (Cl. 255—71.)



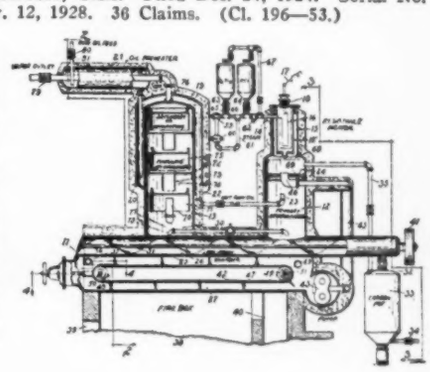
1. A bit of the character described including a body, and a plurality of cutters rotatably carried by the body, the cutters having meshing blades.

1,725,219. METHOD OF AND MEANS FOR RECOVERING PRODUCTS FROM FRACTIONATING CONDENSERS. LESTER W. SNELL, Woodriver, Ill. Filed Aug. 23, 1926. Serial No. 131,012. 5 Claims. (Cl. 196—139.)



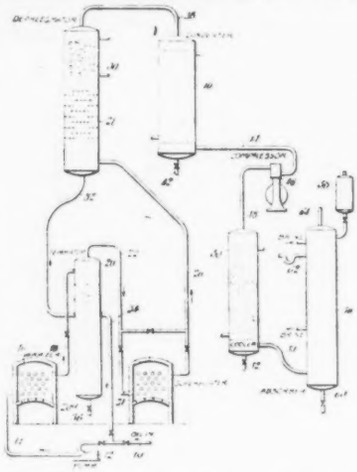
1. In the art of distilling hydrocarbons, the method of obtaining fractional liquid products having predetermined initial and end points, which comprises withdrawing fractional liquid products from condensing zones in a fractionating condenser, maintaining predetermined vapor temperatures at each end of one of said zones by cooling said withdrawn liquid products, discharging portions of one of said cooled liquid products into the vapors entering the last mentioned zone, discharging portions of another of said cooled liquid products into the vapors leaving said last mentioned zone, and varying the flow of said portions in response to variations in the temperature of the vapors into which they are discharged, so as to predetermine the initial and end point of the product condensed in said last mentioned zone, and separately recovering the remaining portions of said withdrawn liquid products.

1,725,320. HYDROGENATING AND CRACKING ORGANIZATION. MILON J. TRUMBLE, Alhambra, Calif. Filed Dec. 24, 1924. Serial No. 757,809. Renewed Nov. 12, 1928. 36 Claims. (Cl. 196—53.)



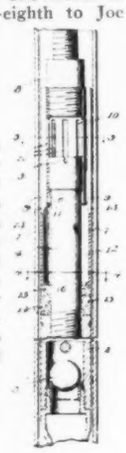
1. In an apparatus of the character described, an equilibrium chamber provided with an outlet for lighter fractions, a hydrogenator disposed above and delivering directly thereto, and means independent of means for supplying new materials for repeatedly passing heavier fractions back from said chamber through both said hydrogenator and said chamber.

1,723,008. **PROCESS OF UTILIZING PETROLEUM HYDROCARBONS.** AUGUST P. BJERREGAARD, Okmulgee, Okla., assignor to Doherty Research Company, New York, N. Y., a Corporation of Delaware. Filed May 3, 1924. Serial No. 710,738. 15 Claims. (Cl. 260—98.)



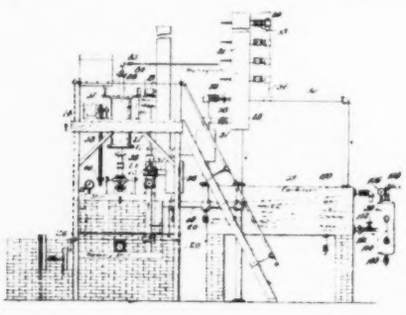
1. A process of treating petroleum hydrocarbons comprising vaporizing said hydrocarbons, cracking said vapors at substantially atmospheric pressure, condensing out benzine from said vapors, and esterfying olefines formed in the gases by said cracking.

1,725,496. **OIL-WELL PUMP.** JOHN C. VROMAN, Chelsea, Okla., assignor of one-half to John R. Ketchum, Chelsea, Okla., one-fourth to C. A. Bickley, one-eighth to Mabel Goodman, and one-eighth to Joe Bickley. Filed Dec. 27, 1927. Serial No. 242,740. 3 Claims. (Cl. 74—109.)



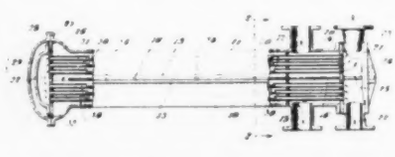
1. The combination of a lower plunger member, a liquid delivery tube attached to and rising from the plunger member, an upper plunger member slidably fitted around the liquid delivery tube and constructed with outlet slots in its upper portion and being further provided in its upper portion with vertically extending grooves through which packing may gravitate, and a packing retainer carried by the upper member and provided in its lower end with outlet openings to permit packing to pass to the lower plunger member, the upper plunger member and the retainer having lost motion upon the liquid delivery tube to effect compression of the packing between the retainer and the lower plunger member.

1,726,280. **PROCESS AND APPARATUS FOR TREATING OILS.** GEORGE D. WHITE, Port Arthur, Tex., assignor, by mesne assignments, to The Texas Company, New York, N. Y., a Corporation of Delaware. Filed Mar. 15, 1920. Serial No. 365,955. 10 Claims. (Cl. 196—54.)



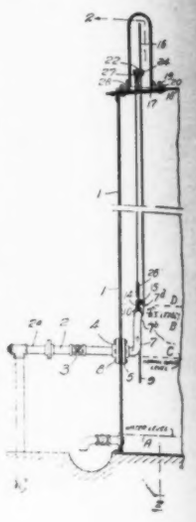
1. Apparatus for treating hydrocarbons comprising a still, a mixing chamber for aluminum chlorid and oil connected with the still, a pair of recovery stills adapted to receive sludge from the main still and connected to discharge aluminum chlorid vapors into the main still.

1,725,549. **HEAT-TRANSFER APPARATUS.** FRANK J. SWENSON, Brooklyn, N. Y., assignor to Foster Wheeler Corporation, New York, N. Y., a Corporation of New York. Filed Mar. 10, 1926. Serial No. 93,549. 3 Claims. (Cl. 257—236.)



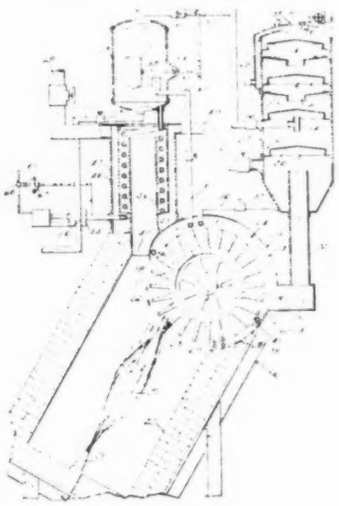
1. In a heat transfer apparatus, a longitudinally divided casing having a flange at one end and an enlarged head and bonnet integral therewith at the other end, a nest of tubes in the shell, a tube plate secured to the flanged end of the casing, and a tube plate movable in the enlarged end of the casing, the ends of said tubes being secured in the said tube plates and the parts of the casing being separable after the first aforesaid tube plate is disconnected therefrom in order to remove the tubes and tube plates bodily as a unit in a direction transversely of the length of the tubes.

1,723,197. **ADJUSTABLE OIL OUTLET.** WELLINGTON S. MONTGOMERY, El Dorado, Kans. Filed June 16, 1927. Serial No. 199,311. 13 Claims. (Cl. 210—51.)



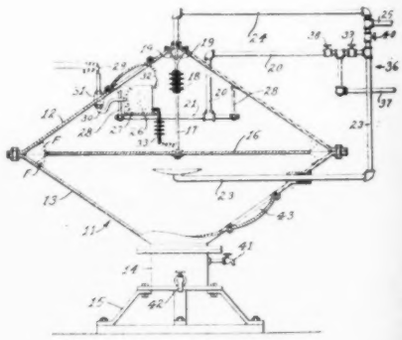
1. In a tank or the like having an outlet, an adjustable outlet pipe rotatably mounted in said outlet and extending into said tank, a prop having a semi-circular portion adjacent one end, a clamp co-operating with the semi-circular portion of said prop to embrace said outlet pipe whereby the prop will support said pipe in a predetermined position, an arm pivoted between said prop and clamp and extending upwardly through the top of said tank, means associated with said arm and tank for holding the pipe in a predetermined elevated position, a closure for the mouth of said outlet pipe, a lever pivotedly carried in part by said clamp and in part by said prop and to which said closure is secured whereby the same can be moved to and from operative position, spring means in part carried by said clamp and in part by said prop for normally tending to maintain such closure open, and a connection attached to said lever and extending up through the top of said tank whereby said closure can be operated.

1,724,982. **OIL-CRACKING MEANS AND METHOD.** MILON J. TRUMBLE, Alhambra, Calif. Filed Dec. 10, 1925. Serial No. 74,430. 10 Claims. (Cl. 196—48.)



1. A process of cracking petroleum oils which comprises: advancing successive portions of a movable member repeatedly through a heat-receiving zone and then through an oil-receiving and vapor-evolving zone; projecting flame thereon in said heating zone; delivering oil thereto in said receiving zone; and collecting the evolved vapors from said last mentioned zone—said flame and said oil successively contacting with identical portions of the surface of said member.

1,724,263. **ELECTRICAL DEHYDRATES.** WILLIAM O. EDDY, Los Angeles, Calif. Filed July 5, 1928. Serial No. 290,423. 14 Claims. (Cl. 204—24.)



1. An apparatus for dehydrating petroleum emulsions comprising: a shell having converging walls forming a surface of angular cross section; an electrode positioned substantially in the plane defined by the vertex of said angular section; and means for establishing a difference in potential between said electrode and said shell.

8. An apparatus for dehydrating petroleum emulsions comprising: a shell formed of substantially conical sections, oppositely disposed, the walls thereof converging toward and intersecting in a substantially horizontal plane; an electrode plate positioned in said plane of intersection, the periphery thereof being spaced from said shell; means for establishing a difference in potential between said electrode plate and said shell; means for delivering petroleum emulsion into said shell below said electrode plate; means for conducting water from said shell; and means above said electrode plate for conducting treated oil from said shell.